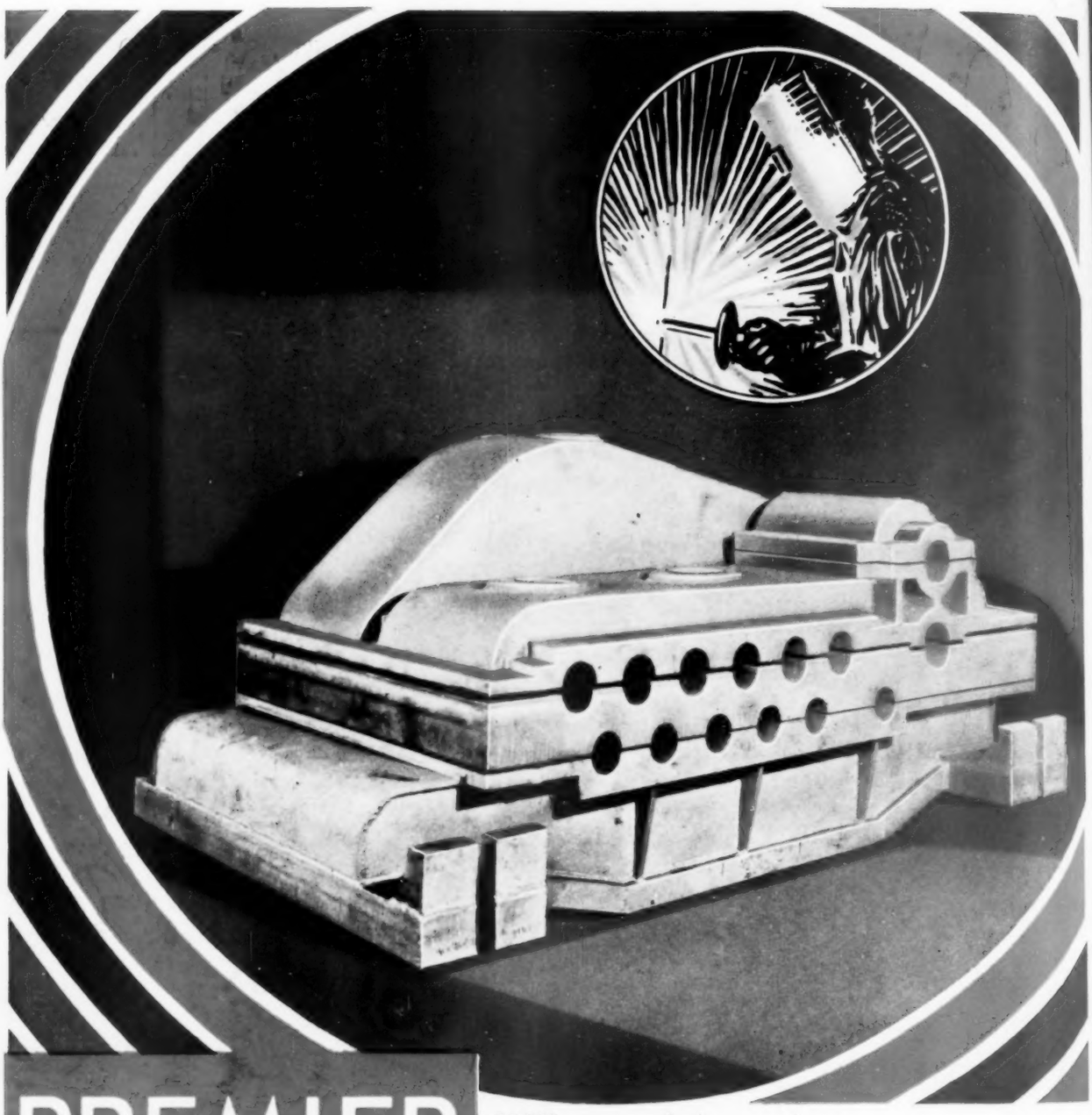
The Welding Engineer

Reg. U. S. Pat. Office

Machine Gun Bullets of Peace. (*See Page 5*)

June, 1932



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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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The Picture on the Cover*

"Machine Gun Bullets of Peace" (see page 24) are liquid particles of metal, shot from guns in the battle which many industries have to wage against corrosion. The process has interesting possibilities as a business builder for the contract welder. It is growing in usefulness for both protection and ornamentation.

*Photo by courtesy of Metallizing Company of Los Angeles.

Looking Forward

in

THE WELDING ENGINEER

●

A brief description of some of the articles selected for next month's issue.

Detailing

Practical suggestions for the preparation of detail drawings and lists of materials entering into the construction of welded steel machinery parts. Illustrated by several designs of typical jobs.

Training

A description of a system of shop training which has proved to be highly successful in a large industrial plant. Here is first hand information on vital personnel problems, the fruit of years of experience.

Metallurgy

Properties of metals and alloys as they affect welding operations are discussed in an understandable treatise. Better welds will be made when these properties are better understood by the welder and his supervisor or department head.

Truck Tanks

Intimate details of design, factors which determine economy, efficiency and safety are discussed by an experienced engineer. Illustrations give full information on the design, fabrication and location of baffles, fittings, supports, etc.

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EDITORIAL

Not Good Enough

OUT of all the inspiring articles on the subject of world conditions which have been written during the present year, there has been none more definitely helpful and more understandable than Mr. C. F. Kettering's recent contribution to the *Saturday Evening Post,* under the title, "The World Isn't Finished." Mr. Kettering promises us that ten years hence we shall be thinking and dreaming about things which are totally unknown to us today. We have only to look back ten years to realize that he is right. Mr. Kettering wants us to realize that the world must improve. The implication is that it must improve because today it is not good enough. In our own industry, it is quite generally recognized that we are in an early development stage and that industry itself will make progress in proportion as it makes the world a better place to live in. It is a sound and inspirational philosophy which fully justifies the effort required for the industrial world to pull itself together, write off the losses due to bad judgment, and start building for better things. It is to be hoped that this endeavor to make progress will not be limited to scientific research in metallurgical laboratories. The whole structure of business must shake off old traditions and emerge in a more perfected form. Salesmanship needs to be made a characteristic of an entire business rather than a single department. In many cases it has been confined so closely that it has degenerated into mere "showmanship." The successes of the next decade will have salesmanship built into them. They will reach their goal by the combined efforts of wise leadership, sound manufacturing methods, intelligent advertising and constructive selling. There are things like this in the making today because there are men who know that the human race wants to improve its living standards, and such men are putting their fortunes, their intellects and their energies back of the ideas which in time will bear fruit in shape of the next era of prosperity and contentment.

Modernizing and Employment

IN the major portion of the important industries of the country there are modernizing programs under way, with the definite purpose of weeding out undesirable conditions, including inefficient methods. This is viewed with alarm by those who think of progress only in terms of supplanting men by machines. However, the fear of adding to unemployment through modernizing is in reality unfounded. Modernizing is one of the paths which leads toward more employment by causing the buying public to exercise its purchasing power. The dollar, by making itself scarce, has come to be treated with more respect. More is expected of it. People will not trade it for the things it bought three years ago. They demand better values, and these values cannot in the main be produced except by improved methods and more efficient organizations. Manufacturing plants can produce these demanded values at a profit by a combination of modern methods, equipment, and materials, and companies which are able to work out such combinations are forging ahead. In these plants and factories, modernizing is making jobs. The automobile industry is setting the pace, hundreds of small factories selling their entire outputs to a single manufacturer who is daily increasing his output as a result of offering an entirely new line of values to the motoring public. The other side of the picture is that "good times," "normal business conditions," "prosperity," or whatever you may choose to call it, will probably never return to those plants whose managers think that nothing is to be gained by investing in new-fangled notions. Modernizing in the metal working industries will inevitably mean more welding and more work for the welders.

The Hoover Dam Penstock

THE opening of bids on the welding of the penstock for the Hoover dam is being awaited this month with the keenest interest by some of the largest industrial corporations in the country. Involving as it does anywhere from five to thirty-five miles of welding in accordance with Class I requirements for pressure vessels, it represents a truly gigantic project. So rigid are the requirements and so many of the factors involved are subject to variation that it requires the highest type of courage for any corporation to submit a bid under present economic conditions. The reported requirements are of such a nature that it will appear to be guaranteed against failure if constructed according to specifications—at least as far as it is humanly possible to guarantee it. When completed, however, it should stand as one job to which the welding industry can point as evidence that welded construction is thoroughly dependable and can be utilized under control which is exacting enough to satisfy any engineering body.

Tell the Farmers

LAST month there appeared a short article containing a list of the jobs that could be done in a year by a welder in an agricultural community, with the approximate amounts that might be charged. A subscriber suggests "telling it to the farmers." It has appeared at times that the farmers are not any too well posted in the value of the welding processes in the repair of farm implements and household equipment, so the point is well taken. The average rural welder has limited funds and limited ability to promote his art, and with some help might be able to collect a big increase in customers, and so become a larger purchaser of equipment and supplies. Some of the time spent telling him what he ought to do might be spent to good advantage in telling farmer groups what the job welder can do to reduce replacement costs on farm implements, or to make things out of metal to suit special requirements. A number of welders have made a success of driving a portable welding shop around from farm to farm, literally ferreting out the job—proof enough that the business is there.

REGORODS for Uniformity

The cost of the welding rod in an average job is less than 2% of the total cost of labor and material used to complete the work.

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THE MONTHLY SYMPOSIUM

Structural Welding

Industrials

Several interesting and successful applications of welded construction to the erection of industrial buildings were made by the late Norman E. Peden of Newallton, La., who, during the last few years of his life, devoted practically all of his time to the construction of welded buildings of the warehouse type in Louisiana. In the course of his experience, he found that even in buildings for similar purposes there was a noticeable variation in the requirements of each making it necessary to have a thorough knowledge of the requirements of each structure, and to develop designs and erection methods flexible enough to be adapted to these variations.

Referring to the illustrations, Fig. 1 is a cotton seed storage house erected at Wisner, La. The size of the building at the foundation line is 35x50x18 ft. The tapering walls reduce this to 20x40 ft. at the roof line. The columns are 10-in. I-beams. The side girths are 4-in. and 3-in. channel beams. The trusses are the Fink type with a 3-in. channel beam lower chord and 4-in. channel beam upper chord, the web members being 2½x2½x⅜-in. angles, and the trusses having a span of 20 ft. Three-inch channel beams are used for roof purlins. This gives an all-steel frame, and both oxy-acetylene and arc welding were employed in the assembly. No erection bolts were used.

The procedure for the erection of the building at Wisner was to place the foot of the columns against the anchor bolts, the columns lying flat on the ground. The truss was then welded to the top and the knee braces were welded in. This whole bent was then raised to its vertical position, plumbed and guyed until the second bent was in its vertical position. Then the side girths and sway braces were welded in between the two bents, forming a rigid structure to hold the other bents as they were raised.

Fig. 2 is a standard type of Four Eighty and Five Eighty cotton gin with straight line roof. Three of this type were erected—one in Alto, La., and two in Golion, La. The columns for the high part are 8-in. channel beams to the height of the press deck, and 6-in. channel beams from there up to the truss. Columns for the low part are 6-in. channel beams. The side girths are 2½x2½x⅜-in. angles. Fink trusses with 4-in. channel beam upper and lower chords and 2x2x¼-in. angles for web members were used. The roof purlins are 3-in. channel beams. The press deck members are 6-in. and 4-in. channel beams.

Fig. 3 illustrates the procedure used in erection of buildings of this type. All columns are placed flat on the foundation and lined up properly. While in this flat position all side girths and eave struts are welded in and all windows put in place. The sway braces are inserted but not tightened. The gin pole is used to raise the entire side thus welded to its vertical position and guyed. In the case of long buildings the sides are welded up in sections. The sides of the building shown in Fig. 3 were welded in four sections, three of which are shown in position with the fourth ready to go up.

After the sides are in place, the trusses are raised to position. Fig. 4 shows the last truss going up. It is put in place and held by clamp screws. Referring again to Fig. 2, there will be seen a long member extending in a diagonal position from the ground. This is clamped to the column and to both chords of the truss. One of the 3-in. purlins is used for this. It is likewise clamped to a stake driven in the ground. After each bent is lined and plumbed properly, the truss is welded in place and the knee braces and the diagonal braces are welded to the lower chord of the truss but are not at this time welded to the eave strut and to the column. After all of the welds have cooled, the connections are examined for warpage, and after this is corrected, the open ends of the braces are welded.

All members were cut to the proper length in the shop and all trusses were welded in the shop, using the electric arc. The oxy-acetylene process was used for the field welding.

It was found that erection costs vary with the location, surroundings and weather conditions. The work represented by Fig. 2 was done by two welders, one foreman and three laborers in 3½ days. The average time for the entire structure including press deck and platforms is about 9 days. It was found that in the shop one welder and two helpers could completely fabricate and weld two 24-ft. trusses in one 10-hour day. The labor and welding cost of making ten 44-ft. trusses for one building was $159.05, or an average of $15.90 per truss. The labor and welding cost of making five 48-ft. Warren trusses for another building was $140.62, or a cost of $28.12 per truss.

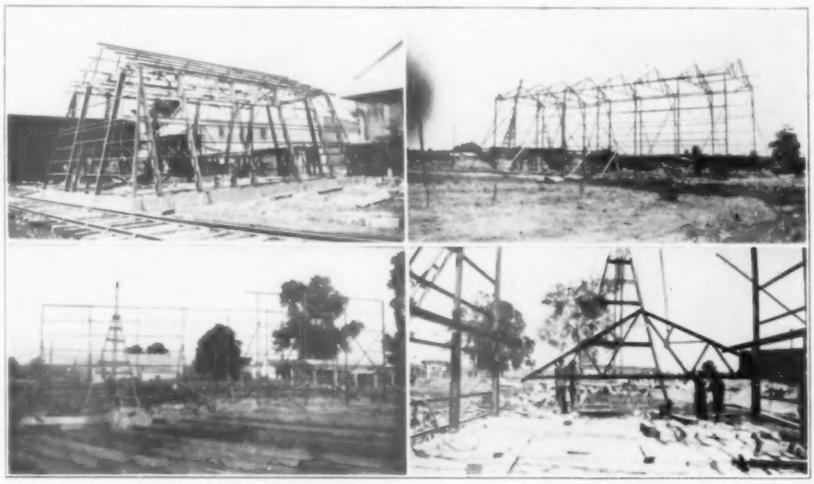


Figure 1 (Upper Left) Tapered Wall Cotton Seed Storage House. Figure 2. (Upper Right) Another Type of Cotton Building. Figure 3. (Lower Left) Procedure for Erecting Buildings of This Type. Figure 4. (Lower Right) Raising the Last Truss.

Noiseless

By Frank P. McKibben†

An interesting result of the campaign against noise is the application of electric arc-welding to the construction of the steel frame of the new City Hospital's Pediatric Building in Boston, Mass. The usual method of joining together the various steel members of building

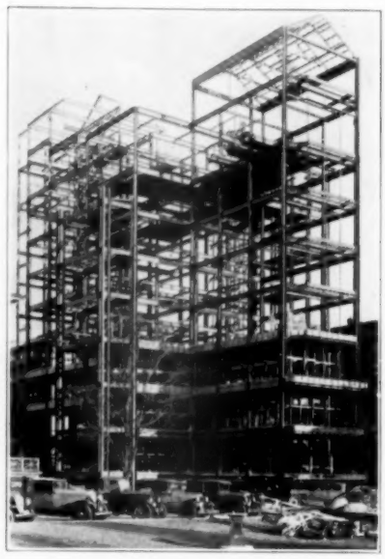
†*Consulting Engineer, Black Gap, Pa.*

frames is by riveting, but in locations where elimination of noise is important, arc-welding is a desirable substitute for riveting. And although welding cannot do away with all noises consequent upon erection of buildings, it does materially lessen those involved in assembling the steel frame. But where a structure is surrounded on all sides by existing hospital buildings in service, as was the case of the Pediatric Building, all reasonable devices for lessening noise should be employed.

The fear of increased costs need not deter one from choosing this quieter method, because the price of welded steel is now no greater than that of other forms. Indeed, in some types of buildings welding is less expensive.

As welded structural steel is relatively new, the first sizeable welded structure in the United States having been erected about 16 years ago, building codes of some cities have not yet been revised to include this form of construction. This was the case in Boston. But the Building Commissioner of Boston, realizing the importance of abating noise within the hospital grounds, granted a permit to use welding. This he did under discretionary powers prescribed in the municipal building code. One hundred seventeen towns and cities have incorporated in their codes, provisions for welding steel building frames.

The Pediatric Building is nine stories high; cruciform in plan, with the main central section 43 ft. in maximum width by 143 ft. long. Each of the two minor



City Hospital Pediatric Building Erected with a Minimum of Noise.

extensions is approximately 12 ft. by 28 ft. From ground level to the highest steel welded is 131 ft. A solarium and a pent house extend above the main roof.

Nearly one million pounds of steel, to be exact 984,000 pounds, were erected and welded at the hospital site between October 13 and December 16, 1931. In fact, welding was performed at the site by two welders and one welding foreman in the period October 23 to December 16, during which time they deposited a total of approximately 3000 lineal feet of welded fillets at the various connections in the steel frame. Sufficient bolts were used to draw the parts tightly together preparatory to welding.

Not only were all joints erected at the building site by welding, but in the steel fabricating shops, the various individual supporting columns and floor beams were assembled and made ready for the erection by welding. The result is a 9-story hospital building containing 492 tons of steel joined together with the noiseless electric arc.

The structure was designed architecturally and structurally by James H. Ritchie and Associates. General Contractor, John Bowen, Inc. Palmer Steel Company, Daniel Marr and Son Company, Mellon, Taylor, Hendrickson, Inc., did the fabrication, erection and field-welding of the structural steel respectively. J. T. Whitney, President the Whitney Engineering Company assisted by A. S. Coombs, Engineer, with the same company were consulting engineers on welding. The writer was associated with Mr. Whitney in an advisory capacity.

Special Applications

Manganese

By B. H. Payne†

There is a definite reason why users originally purchase 11 to 14% manganese steel castings and up until only a recent date they had been discarding them as scrap, after only about 20% of the casting had been used. With the recent developments in manganese steel electrodes it is now possible to reclaim from these scrap piles castings that have been discarded and put them in 100% condition again for only a small portion of the cost of new parts. An enormous quantity of work of this kind is available.

Manganese steel castings are used in a great many industries such as the coal, coke, cement, iron, copper industries, and every contractor who does excavating of any kind is a possible customer for the job welding shop. Some of the many items they can reclaim are manganese steel dippers, dipper fronts and teeth, manganese steel buckets, teeth and lips, gyratory and concave crushers, skip wheels, gears, sheaves, crusher liners, cast manganese steel screen segments, centrifugal pump shells, impellors and cutting blades.

Only a few of the quarries are equipped to do their own electric arc welding and a great many of the other industries, while equipped to do electric arc welding, much prefer to send out this kind of work to a job welding shop that can guarantee the part. We know of a number of job welding shops that in the past year have been able to weather the economic conditions due to the fact that they have solicited and obtained a great deal of this kind of work. But it is by no means being universally adopted and it remains for the job welding shop to interest and educate their local users that parts of these kinds can now be reclaimed, not only once but many times, and that it is no longer necessary to purchase a new cast manganese steel part. The old one, after it has been built up, is a better casting than it was originally, due to the fact that any weak metal in the casting has shown up in operation and all of the weak parts are welded and filled up with a better grade of steel than was originally in the new casting. In other words all of the aches and pains of the original casting have shown themselves and after being repaired you have a much better product than the original casting could ever be.

†*Manager, Stulz-Sickles Co., Newark, N. J.*

Preserver

An unusual application of the oxy-acetylene flame for the preservation of timber is described in a recent issue of the *Mechanical & Welding Engineer* (Australia). According to this report, recent investigations have proved that the oxy-acetylene flame can be used to advantage in the charring of timber which comes in contact with the ground. Several investigators have worked in conjunction with the Research Department of Allen-Liversidge, Ltd. (Australia) on a series of experiments with the new system. It is common knowledge that the charring of posts, telephone and telegraph poles, railroad ties and other timber in contact with the ground increases its life enormously. The electric light poles in the city of Melbourne have been standing under test for a matter of twelve years with almost no replacements necessary. Ordinary hard woods show quite a marked

variation in the way in which they resist rotting and decay when trimmed and inserted into the ground. Constant inspection, testing and maintenance represent a source of continual expense to companies using wooden poles or posts. It has also been noticed that charred logs or stumps have had a treatment which hardens the wood or seasons it and at the same time puts it in a condition to resist decay in a most remarkable manner. Based on this fact, charring has been resorted to in the past as a preservative. However, more recent investigations have indicated that the oxy-acetylene flame can be used to do a better job, producing a smoother, neater surface without severe cracking. The work is done with the conventional oxy-acetylene apparatus employing a straight multi-jet tip on the torch which produces a brush-like flame. The results claimed are, first, the intense heat of the oxy-acetylene equipment gives a hard carbon face, with just that amount of porosity which makes it an excellent vehicle for taking up any water proofing material when that is considered necessary; second, the charring is rapid and does not open up a source of coarse cracks, which tend to weaken the adherence of the charcoal so that in handling there is a risk of removal of the char; third, the operation is so rapid that there is a minimum of burning, and this obviates the production of ash which is quite a regular feature with other methods of charring. The production of ash means that the carbon, or some of it, has burned off, but when the ash from mineral matter is still held by the carbon and brought to a state of fusion, the result is a very much harder and more resistant material in every way; fourth, the portability and convenience of the equipment with the quality and speed of the work make this an ideal means of extending the life of the material and reducing maintenance and upkeep costs.

Brass, Drawn and Extruded*

Tubing—Considerable progress has been made in the welding of copper or brass tubing to various types of headers, cast iron, steel, mallable cast iron, bronze, brass and other copper alloys. One or another of the yellow bronzes is usually employed, though silver solder is sometimes used. Frequently, the entire surface of the header, if it be steel, as in feed water heaters, is coated with a copper alloy, thus protecting the header from corrosion and at the same time welding the tubes into place.

Soft solders are being used for connecting copper and brass tubing in domestic and public buildings, but the harder brazing alloys which are not subject to failure by low creep stresses, as are the soft solders, are growing in favor. As in the case of steel piping, more and more brass and copper tubing is being installed by welding or brazing, replacing threaded connections.

Extruded Shapes—There has been a marked increase in the demand for metal window frames and sash using several types of copper alloys. One alloy is extruded into the special shapes desired, and welded at the corners. Most of this material is of a high-zinc, high-lead composition, and has to be matched by a yellow bronze weld metal such as Tobin bronze. Another type of metal is a White Benedict nickel which has to be welded for a color match with a nickel-silver rod. A third type of metal which is bent or drawn into shape consists of a high copper alloy with a small percentage of manganese and silicon added. This would be welded by a material of the same composition.

*From the 1931 report of the Oxy-Acetylene Committee of the International Acetylene Association.

Production and Fabrication

Signs

Ed Wright, of the Oceanside Welding Works, Oceanside, Cal., recently conceived the clever idea of manufacturing welded signs for advertising ice cream cones and other dairy products.

The accompanying photo of one of these signs illustrates the attractiveness of the signs, a large number of which he has already made and sold to local dairies and ice cream plants and distributors.

The cone of the sign is made of a heavy gauge sheet metal, the top of which is cut by the acetylene torch to shape, from a pattern artistically designed in the form of the ice cream portion of a well-filled ice-cream cone. From the top of the cone proper (on each side) to the bottom, is welded a strengthener of about ¼x½-inch strap iron, brought to an attractive ornamental curl at the bottom ends, as can be seen in the photo. The bottom of

It Looks Good Enough to Eat and It Brings in the Customers.

the cone is welded to a piece of two-inch pipe which is in turn secured to the base of the sign by a heavy and substantial weld. The base, or holder, of the sign is of ordinary band iron about two inches wide, with two cross piece of two-inch strap iron welded securely to the band iron and to the end of the piece of pipe in the center forming the support, or holder, of the cone.

When completed, the sign is attractively painted by a commercial artist, and very strikingly represents a huge ice cream cone. The sign is made of sufficiently heavy material to prevent twisting or bending out of shape; and by virtue of its welded construction, it is very rigid and capable of withstanding rough handling. It will not easily blow over even in a hard wind, and in case it is overturned, there is little or no damage. Larger signs similarly designed and constructed can be made for country highway signs, the main precaution in such cases being in seeing that the sign is properly anchored in concrete or otherwise for security.

Production Rates*

Data on structural steel buildings welded in the field show a net average deposit of 50 inches, ⅜-inch fillet weld per man per hour.

We find in shop work that a man can make a ⅜-inch fillet at the rate of 2¼ inches per minute or 135 inches in sixty minutes. It is evident that the difference between 135 inches and 50 inches represent time which the workman in the field is doing something else besides welding.

A turbo-generator stator frame as made in a factory is somewhat similar to the frame work of a building. A case in point may be quoted of a frame seven feet long, seven feet three inches high and eight feet five inches wide having total weight fabricated of 6,700 pounds (cast iron, 19,000 pounds). This frame consists of six main plates each weighing 900 pounds, and 125 miscellaneous air pipes, spacers, etc., which must be welded in position. Approxi-

*From a paper read by P. J. Horgan of the General Electric Company before the Ninth Annual Convention of the American Institute of Steel Construction.

mately 7,000 inches of welding of which about 6,000 inches are ¼-inch fillet. The time allowance on the entire job is 110 hours. Average welding per man per hour total 64 inches, indicating two-thirds of workman's time is spent getting his work ready for welding.

On this frame are 18 bars weighing 50 pounds each and 60 inches long which must be accurately located and welded in position within tolerances of —.000 inch and plus .010 inch diameter. On this job there is a total of 432 inches of ⅜-inch fillet weld. The time allowed for welding is 38 hours, or welding at the rate of 11½ inches per hour.

This last data shows that when a man has to spread his welding from place to place to minimize distortion to get accurate dimensions, checking virtually every move he makes, that the greater part of his time is spent in assembling and inspecting rather than in welding.

Another example may be quoted of a sole plate 11 feet long, 5 feet nine inches wide and 12⅞ inches high using 12-inch by 36-pound I-beams as longitudinal members and 12-inch by 34.5-pound channels for cross members with 40 miscellaneous pads and braces to complete the structure. The total weight is 1,900 pounds, and total welding 1,050 inches of ⅜-inch fillet weld. The total time allowed for welding is 18 hours, or an average per man hour of 58 inches.

Because of variations between webs and flanges of the I-beams and possible slight twist in the beam as a whole we are obligated to do all our gas cutting and fitting of these members right on the job. A saving of 10 to 25 percent could be made if each member could be cut to individual detail drawings and given to the welder ready to weld.

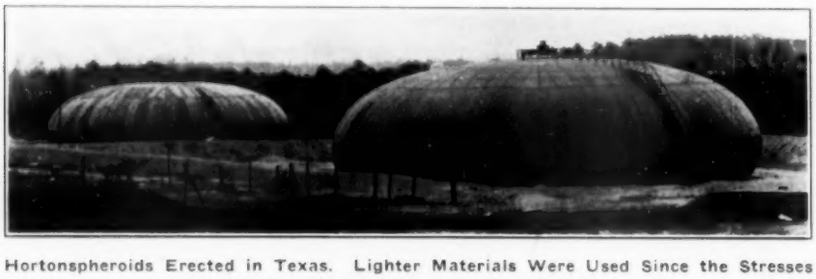
On production work we have data on work where 200 inches of ⅜-inch fillet weld, starting an arc 100 times, is regarded as basis for one hour's work where 3 pounds of ⅜-inch diameter electrode is used.

In another case 100 inches of ⅜-inch fillet weld plus 100 inches of ¼-inch fillet weld constitutes an hour's work, starting an arc 48 times per hour, and 4½ pounds of ¼-inch diameter electrode is used.

Specimens in Suspension.

Spheroids

As every school boy knows, a round field can be fenced with less material than a rectangular or triangular plot containing the same area. Working in the third dimension as is appropriate for storage tank construction. The Chicago Bridge and Iron Works, Chicago, utilized this rule in the design and construction of two 80,000 barrel storage tanks. These spheroidal tanks, known as Hortonspheroids, are used for oil storage at Longview, Texas by the East Texas Refining Co. Their construction required less material than cylindrical tanks and because the stresses in a spheroid, due to double curvature, are less than in a cylinder, lighter plate was used. The spheroids before painting are shown in the accompanying illustration.



Hortonspheroids Erected in Texas. Lighter Materials Were Used Since the Stresses Are Less in Containers of This Shape.

The flat bottom of ¼-inch plate rests upon a graded earth base and supports interior columns which carry the roof. Truss frames are used to reinforce the sides. The shell itself is ⅜-inch thick, while the roof includes ⅜-inch to ⅝-inch steel plate.

All joints were lap welded by the shielded arc process using "Stable Arc" welders and "Fleetweld" electrodes manufactured by The Lincoln Electric Co., Cleveland, Ohio. The tanks were completely welded in the field with no preliminary shop fabrication. Each tank is 136 feet in diameter and 40 feet high.

An interesting fact pertaining to the design of spheroids is that if these tanks were increased to 1,000,000 or 10,000,000 barrels capacity the height would remain constant. Only the diameter would be increased to accommodate the larger volume.

Corrosion

The effect of corrosion is becoming so important in welded boilers, pipes, containers for oil and chemicals that the Westinghouse Research Laboratories are studying it with special apparatus. In welded structures of rustless steel, alloys, or monel metal this problem is vital. The results of these studies may tell engineers how to fabricate structures so that all parts will be uniformly resistant to rust.

In a weld of low-carbon steel, corrosion may be expected to start in the zone where weld metal meets parent metal. At this point, according to the electrolytic theory of corrosion, a potential difference may exist which is responsible for an accelerated attack. Oxides and other heterogeneous particles, if present in the weld, tend to hasten corrosion by the formation of electrolytic cells. The soil corrosion of pipe line is an example. A more homogeneous weld should be expected with coated welding wire than with bare electrodes since the coating resists the entrance of foreign elements.

To corroborate many facts already known on this subject and to uncover others, a special corrosion device has been built which greatly hastens the slow process of rust. In it the test specimens are subjected to intermittent immersions in a corroding liquid. The

Corrosion Testing Machine.

apparatus suddenly immerses the samples for a definite period, leaving them at rest, and then removing and exposing them to air for a definite period. They are moving only when being lowered or raised—a time which is a very small fraction of the cycle.

Samples are suspended from a rack by glass hooks, horse hair, or silk, and a motor-driven crank shaft raises and lowers the rack. The driving motor is controlled by a timing device composed of a synchronous motor operating a contact, which causes the motor to periodically turn the crank shaft a half revolution. The timing can be set for any cycle of test operation. To obtain reproducible results the corrosive liquids are kept at a constant temperature, by circulating water of a constant temperature along the outside of the vessels containing the corrosive liquids.

Miscellaneous

Overhead

Everyone who has had experience in the supervision of welding operations knows that there are certain types of jobs which have for years been considered particularly difficult and from which the beginner is inclined to shrink. The position weld in the pipe installation is a good example because it involves a good deal of overhead work and is often used as a test of the pipe welder's ability. Some helpful hints on this subject were given by Mr. S. H. Jones of the Burdett Oxygen Company, Chattanooga, in a talk which he delivered at the Welding Conference held at the George School of Technology in January of this year.

"Your plants have numerous pipe systems that are from time to time subject to many changes," says Mr. Jones. "Why not employ the most efficient method of installation. . . . By this I mean to consider strength, cost and time. Most of you would say, 'I have never done any overhead work.' Very well, suppose we give this point a few moments of our time. Overhead welding isn't so difficult as it sounds, if we are careful of a few of the essential points of the work. Assuming that you have cut and placed the lengths and angles of the new work, we prepare for the overhead weld.

"Consider the wall thickness of the pipe as you would a piece of sheet steel in flat work and select your tip accordingly, remembering that tips too large or too small will cause you trouble. As we were careful of the tip size so we will be in the selection of our filler rod. We now light our torch and adjust for the neutral flame.

"Holding the torch in the most comfortable position we apply the heat at the point selected. Presently there will be noticed a movement on the surface of the pipe and then there forms a drop of molten metal. Now if you have selected the proper tip and have the correct flame adjustment this molten metal doesn't fall as we might think, but clings to this hot section just as a drop of rain hangs from the eave of the house. We now place the end of the rod in the molten metal where it quickly fuses and adds to the molten portion. Now remove the rod, then the flame, the chill soon sets this deposit and we move to one side and repeat the operation, being sure each time to bring the base material to a molten heat before adding the filler rod.

"In a very short time you will be able to make an overhead pipe weld according to the standard practice of the day, that of continuous flame and rod action throughout the weld."

School Training

By R. G. Knapman†

Technical training in the State of Victoria is controlled by the Education Department or Department of Public Instruction. The Working Men's College which forms one link in this system of technical training has the biggest welding school in Australia, instruction being given in both electric welding and oxy-acetylene welding and cutting. The classes which are conducted both day and evening are of two main types, namely trade classes and what may be termed supplementary classes.

Trade classes as separate classes in electric welding and oxy-acetylene welding are conducted to meet the needs of those artisans requiring to use the welding unit as another tool of trade, hence preference of admission to these classes is granted to boilermakers, blacksmiths, coppersmiths, engineers, plumbers, motor mechanics, etc., whereas the supplementary classes are conducted for, and form part of the general training comprising a full trade course for apprentice motor mechanics, apprentice plumbers, and diploma engineers. Cutting also forms part of the course prescribed for electric welding.

The minimum time for a full course in each case is 220 hours. Both courses include practical and lecture work, the necessary relationship between the two being maintained by means of suitable exercises, lectures being illustrated by both lantern slides and small films portraying the process.

The exercises are designed to give a thorough grounding in the fundamentals of the processes. The first exercises are being practised in what may be termed the "comfortable position," the work positioned or turned to suit the comfort of the operator, and the main objective at this stage being to develop a proper sense of, and control of the change of state which takes place in the metal, and complete muscular control.

These exercises are tested to destruction to gauge the measure of progress made, which, if satisfactory, enables the student to proceed with the full series of progressive exercises which are based upon methods of application in workshop practice.

These exercises—necessitating work under varying conditions and requiring the use of different gauge electrodes or filler rods with accompanying heat adjustment—current or torch tip size—give a thorough grounding in the fundamentals of and the correct methods to be followed in welding practice, so that the exercises develop the required weld conscientiousness, skill, and resourcefulnes necessary in a competent artisan. The exercises also include welding practice in different positions such as horizontal down, vertical, and overhead in the metals weldable with the various processes.

Principles of welding design are imparted in the engineering drawing and draughting class. Engineering diploma students thus have the opportunity of being fully conversant with both design and application.

The progressive exercises are set out and issued to the student as a blue print and on completion are checked on a "work standard basis" so that the incentive to excel is continually being instilled in him.

Contact between school and industry is maintained by the engaging, as part time instructors, men actively engaged in welding practice who work under the direction of the Head of the Welding School.

An independent examination is held at the end of the school year, the examiner in this case being selected from those not associated with the school but actively connected with the welding industry.

Students successful in passing the independent examination may obtain a written statement to that effect, and when able to produce satisfactory testimony of 12 months' workshop welding experience become entitled to a proficiency certificate.

Contact with industry is further maintained by means of visits to various welding firms during the course of the school year.

†*Melbourne, Australia.*

Applying Two Coats of Metal to An Airplane Motor Cylinder —Copper on Top and Zinc on the Lower Section—to Determine if This Application Will Cool the Motor More Quickly.

A process half a century old is just beginning to make its usefulness felt. A study of the huge losses due to corrosion of unprotected surfaces is one factor responsible for today's rapid growth. Another factor is the demand for metal surface finished in modern decorative plans. Welding shops in some cities have used this process as a source of new and profitable business.

Machine Gun Bullets of Peace*

By L. E. Kunkler†

IN 1882 a German inventor patented a process for shooting a spray of metal bullets, by which an adherent metal sheathing could be applied to most anything one wanted to protect against corrosion of the weather.

Not until the World War, however, was it given serious consideration, when, due to the shortage of copper in Germany the copper bonds between traction rails were replaced with iron, sprayed with zinc. The results of this change were so satisfactory, that the practice has been continued. In the meantime the process has found countless uses in industry. The engineering staff of The Metallizing Company of Los Angeles, Ltd., have devoted their efforts during the last eight years to building a metal spray gun that could be operated by industrialists in their plants, using the information that we have gathered and set up in a Technical Data Manual to guide them.

Briefly, the process consists of feeding wire into a melting flame and atomizing the molten metal. This is accomplished automatically with the Metallizer which contains a wire feed mechanism, and wire melting chamber. An oxy-hydrogen or an oxy-acetylene flame is used to melt the metal, and compressed air operates the wire feed turbine, and atomizes the metal after it is melted. The molten particles are so tiny that they are cool almost immediately upon striking the surface being coated, despite the fact that they have been in a flame temperature as high as 5200 degrees Fahrenheit, and leave the Metallizer at a speed of over five miles a minute.

The coatings are primarily for protective purposes, but are equally acceptable in the decorative field. Ornamental iron and buildings themselves are sprayed with bronze, brass, nickel silver, aluminum and other metals and alloys. Wood and even paper can be treated as easily as metal, cement, terra-cotta, plaster, porcelain, glass and other non-combustibles.

Metallizing has manifold uses in the industrial field. Defective castings can be salvaged, undersized or worn shafts built up. Large and small tanks subjected to corrosion from various conditions can be coated with a satisfactory metal from .002 to .018 thickness, depending upon the condition to overcome. In the coal and oil burning districts, cast-iron bars are sprayed with aluminum, which doubles their effective life.

In the dairy field cheese mixing vats, milk copper coils and glass lined tanks are put into condition with tin coating.

Each metal has its own field, and our research department has determined the uses of every metal. In the Technical Data Manual is listed every corrosive and erosive condition showing the kind of metal to use, and the number of coats necessary to counteract the condition.

*From a paper read before the First Southwide Welding Conference, Alabama Polytechnic Institute, Auburn, Alabama, May 27, 1932.

†President, Metallizing Company of Los Angeles, Ltd., Los Angeles, Calif.

Any metal that is procurable in wire form can be sprayed, and the speed of application depends on the melting point of the metal. The average single coat of metal has a thickness of about .002 inch, but any number of coats can be applied when a thick coating is desired, and it is further possible to polish or grind the coated surface without running the danger of the coating peeling or flaking.

It is possible with our process to give 100% protection to all large boilers and tanks, as well as structural units that are built up of galvanized plate.

In fabricating large tanks from galvanized plate, it is necessary to weld these plates together and the welding operation burns off the galvanizing. The welding shop having this equipment in the plant is able to throw a thin coat of zinc over the weld, giving the structure or the tank, a 100% zinc coating. Today a great deal of the structural steel work is being welded together instead of being riveted, and the engineers and architects are trying to devise ways and means to reduce the paint and upkeep cost of these structures. With Metallizing they are able to gain this end. The welder, having our equipment in the plant, will be in a position not only to perform the welding operation, but also the metal coating of these structures. In large water tanks and acid tanks that are fabricated and welded together, metal coverings are being specified to give added life to the tank, and also to protect it.

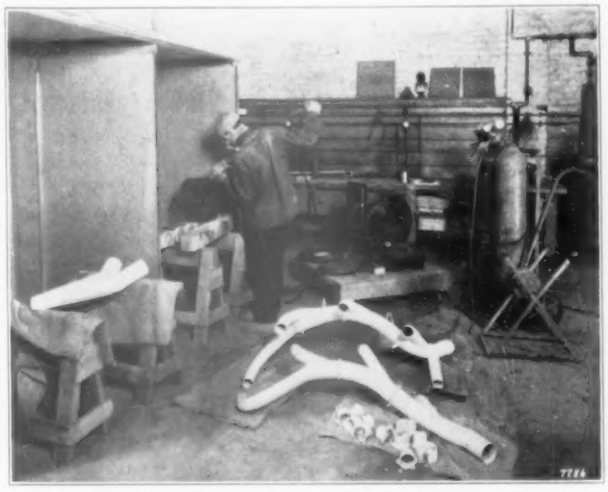
Metallizing does not take the place of welding, but it is an important operation that follows welding. In other words, as we have tried to show, in the fabrication of tanks there is always a welding operation, and now as a final step, since the introduction of this process, the manufacturer is having these tanks or boilers coated by it, with a metal that will solve the problem and increase the life of the equipment. The welding industry should be in a position to know this process as well as welding, with the idea of having equipment to perform both duties.

Our Engineering Staff is glad to work with anyone for the furtherance of the process, as well as to assist any large and recognized industry in applying it in their field,

Applying a Coating of Aluminum to a Special Pressure Cooker to Prevent Heat Corrosion.

whereby it can increase their profits as well as effect great economy to the industrial world.

The job welding shops have not shown very much interest in this process in the past because they have considered it to be a special process for use in certain large industrial plants on a production basis. This situation is rapidly changing. Owners of job welding shops in a number of cities have recognized that this new tool is valuable to them because of its great flexibility. They are installing the apparatus to do the work on a jobbing basis and they are having splendid success with it. The job welder comes in contact with many different kinds of



Practical Applications of Corrosion Resisting Metals. This is the Type of Work a Job Shop Might Do Profitably.

plants and sees metal articles working under all conceivable conditions. Therefore, when he has the equipment, he recognizes many possible applications for it in the plants of his customers. Quite often the volume of the work possible is not enough so that the customer wants to buy the equipment and do his own work; but still the advantage of the coating obtained is so great that it is a good investment for him to pay to have the work done at a rate which gives the shop owner an attractive profit. This is not by any means the end of the story for the job welder. Those who have gone into this business in a progressive way have found that the jobbing business in coating various articles, including tanks, is the means of getting additional welding contracts. In other words, the installation not only secures some profitable business for itself, but is the means of building up the volume of welding at the same time.

The Ideal Application: Structural Steel Shop Fabrication

By Paul B. Covey†

Here we are at the shop from which the steelwork came for that all-welded steel frame building we have been studying—and how different the place looks from what I expected. Usually there is one large building through which the steel is routed in the process of fabrication.

But here there is an auxiliary building or annex running along beside and parallel to the main building. All material enters the main building at this end. However, just after passing through the shears, we see that certain pieces are moved straight ahead as usual but the balance is sent off sideways to the new annex, where the welded material is prepared. No nerve-wracking riveting hammers—only faint hissing sounds with occasional squeaks and groans from portable electric grinders.

Another thing! Where are those rays from the welding

†*Consulting Welding Engineer, Manchester, N. H.*

arcs? All we can see are faint bluish flames which are not in the least disturbing. No one, except the welders themselves, are wearing any protection to the eyes—and even they are using only small goggles covering just the eyes. They are using a type of electrode just put on the market. It is flux-coated with a preparation which is really marvelous. It is responsible for the depositing of an unusually ductile weld and a remarkably smooth looking one and it causes a vapor to be thrown around the arc which absorbs the harmful rays, letting in only a faint bluish tinge. What a blessing that is—no more brittle welds—no worries about what type of stresses are brought to play upon the welds for they will resist with almost equal degree all kinds of stresses, tension, compression, shear or torsion and above all, no more sore eyes.

Did you notice how nicely the shop is laid out? Right near the doorway through which the material enters direct from the shears we find a series of low, level horses. It seems that these are used for "laying-out benches," for the location of all connection details and for all notches, copes and so forth. Small shears located just beyond this point cut up, notch and cope all small detail material which has entered the shop direct from the yard in stock lengths.

Another interesting thing is the absence of the usual mass of welding cables and leads so commonly found scattered all over a welding shop. Close scrutiny reveals the fact that all such cables, carrying current to various parts of the shop, are laid under the floor in well insulated conduits and emerge only at certain outlets located at various convenient spots throughout the shop. All grounds are likewise buried out of sight. All that remains visible are the actual welding leads themselves and these are very short, hardly any running more than twenty feet in length. There can be no question but that, with such a system of installation, replacement costs will run very low. The advantages to be derived are well worth the initial expense. There is no question about that.

Now, let's stop a moment to examine the equipment this welder is working with—but, say, do you see the time? We must be hustling back home. However we must surely come again and continue our interesting discoveries.

So, next month we will inquire further for "More Ideals in Structural Steel Shop Fabrication."

Welded Construction Used in Oil Field Safety Equipment

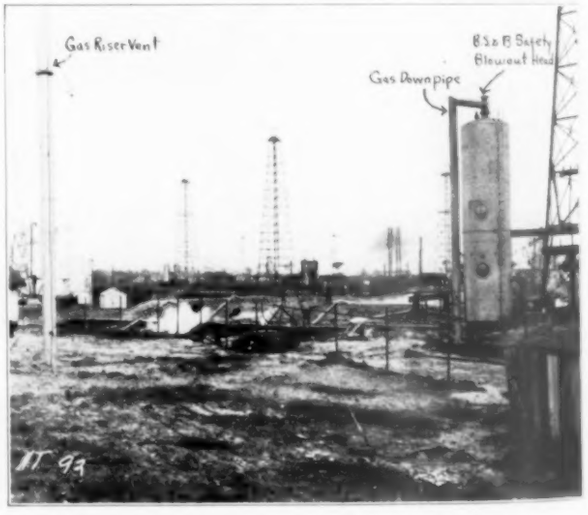
The illustration shows an installation of an American 7x27 ft. cone bottom separator at Phillips Petroleum Company's Gallman No. 1 well, Oklahoma City field. This well flowed on January 20th at the rate of 52,000 barrels oil and 61,000,000 cu. ft. of gas per 24 hours through the separator.

It shows the special safety features developed by the Black, Sivalls & Bryson organization for the large wells in the Oklahoma City field. Because this well is within the City Limits of Oklahoma City, because of the tremendous volume of oil and gas which these wells deliver, and because of the high well pressures (2500 lbs. per sq. in.) city authorities have been insistent that proper measures be taken to provide safety to residents and property within the city.

In the operation of these units, the oil is removed from the separator and the gas escapes through the gas downpipe as indicated. The oil and gas separator is designed to operate at a maximum working pressure of 150 lbs. per square inch. This pressure is regulated by a B. S. & B. 14-in. gas regulator valve. This valve is designed and fabricated in the American Tank & Equipment Corporation shop at Oklahoma City, a subsidiary of Black, Sivalls & Bryson, Inc. of Bartlesville, Okla. The 14-in. valve is said to be the largest partially balanced gas regulator valve of its type ever built for use in the oil industry. It is fabricated entirely out of steel plate, welded and machined at the Oklahoma City plant.

In the process of manufacture, a separator is tested for twice the working pressure or 300 lbs. Occasionally, through faulty operation, or from causes not under control of the operator, pressures in excess of 300 lbs. are thrown upon the separator. When this happens, the separator may "blow up." To prevent the destruction of vessels in this manner, a safety blowout head has been designed, which is installed in the gas discharge line immediately above the separator. This safety head is a copper diaphragm designed to blow-out at a specified pressure. In this case a 10-in. diaphragm is installed, of the proper thickness to blow out at 225 lbs.—midway between the working pressure and the test pressure of the vessel. If the pressure in this separator reaches 225 lbs. the diaphragm blows out, leaving a clear 10-in. opening to the atmosphere through which gas may escape.

Because of the large volume of gas handled by these separators, it has been the custom in the past to equip each of the gas downpipes with a manifold and two or three 8-in. gas regulator valves. From these valves ran individual 8-in. lines to vents, which permitted the gas to escape into the air. However, because they were in the



Welded Safety Equipment in an Oklahoma Oil Field.

city, the city authorities have felt that a danger existed in throwing such a large quantity of gas into the air.

To meet this situation with greater safety, and with the further thought of simplifying the work of installation on the part of the operator, the Black, Sivalls & Bryson organization have designed and built a 16-in. welded gas line which connects on the discharge side of the 14-in. gas valve and rises 60 feet in the air. This gas riser vent extending 60 feet in the air provides an opportunity for the dispersion of these gases before they can come in contact with a flame or spark, thus preventing fires.

Automatic Welding Head Building up a Worn Flange and Tire on a Mining Locomotive Wheel.

Saving 75% of the Cost of Replacement

By A. M. Candy†

With car wheels wearing out continuously in service, new ones costing thirty-four dollars and welding costing seven dollars, every wheel repaired represents money in the bank. Welding methods now in use take care of all the difficulties which have been encountered in wheel welding, and these savings have been put on a production basis in a large number of mines.

WORN tires on the wheels of mining locomotives can be built up to their original section quickly and economically by the arc welding process. To carry such work to a successful conclusion, however, requires the observance of and careful conformity with certain very definite rules of operation.

In the first place, the work must be performed by a reliable automatic welding head such as the "Weldomatic" illustrated by Figure 1. The automatic welder is absolutely essential for three reasons; first, no operator can weld with sufficient speed by hand to make the work economical; second, a weld manually made cannot be produced as uniformly as an automatic weld; and third, no manual welder can successfully weld with the wheel and tire raised to the temperature required to produce a finished job which will be sufficiently free from cooling strains to assure freedom from subsequent breakage.

These statements may sound quite formidable to those familiar with the welding of street railway car wheel flanges but a little thought will readily disclose a decided difference in the applications. In the case of wheel flange welding as a rule not more than five or six beads of weld metal are required to provide sufficient stock to permit refinishing the flange to the required contour. As a result, a relatively small amount of metal is actually added to the wheel; and furthermore, the temperature of the wheel when the welding is finished will not be increased a great deal above its initial temperature. As a rule, however, mining locomotive tires are allowed to operate until a very deep groove is worn in the tire. Very frequently these grooves are $\frac{5}{8}$ inch to $\frac{3}{8}$ inch deep and 2 inches to $2\frac{1}{2}$ inches wide. It is obvious therefore that a relatively large number of beads of weld metal representing a number of pounds of steel (Figure 2) are required to provide sufficient stock to permit refinishing the tire to the required contour. As a result of the welding work, the temperature of the tire and wheel will be increased very materially. But of still greater importance, a relatively large amount of steel

†Welding Engineer, Westinghouse Electric & Mfg. Co.

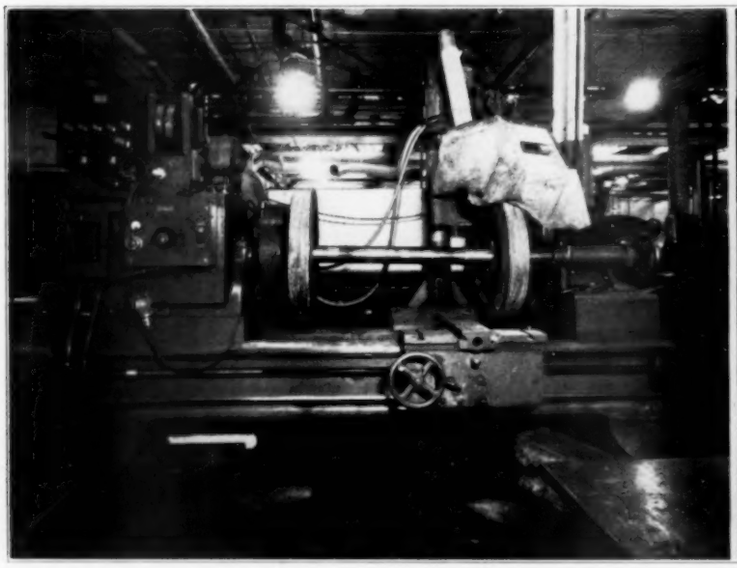


Figure 3. Wheels Mounted in Lathe for Welding. By This Means Speed of Deposit is Controlled and Good Quality Welds Obtained.

Figure 4. After Welding the Preheating Flame Remains on for a Time. This Shows Appearance of Tire Before Machining.

(welding wire deposit) located at the outside diameter of the wheel has cooled down from the molten temperature (3000° F.) to room temperature. As a result, very high contractional stresses will be set up. It is not surprising therefore that if welding is started on a cold (room temperature) tire and wheel, the tire will crack when it cools down again to room temperature.

All of these difficulties can, however, be very readily avoided in a relatively simple manner. First the wheels should be mounted in some device such as a lathe, Figure 3, arranged to drive the wheels at a peripheral speed of about 12 to 15 inches per minute. A heating means should be provided such as a gas flame, preferably using a burner which will cause a number of small flames to inpinge about ¼ to ½ of the circumference of the wheel. The wheels should be started to rotate and the gas burner turned on. When the wheels and tires have reached a temperature of 500° F. welding may be started. The gas flame should then be reduced so that the heating of the arc plus the gas flame will not raise the tire temperature above 850° F. at any time. After the welding is completed the gas flame should be gradually reduced so that the tire temperature will be brought down to 300° F. in a period of about two hours. The flame can then be turned off and the wheel and tire allowed to cool down to room temperature. Figure 4 shows the appearance of a finished tire before being machined.

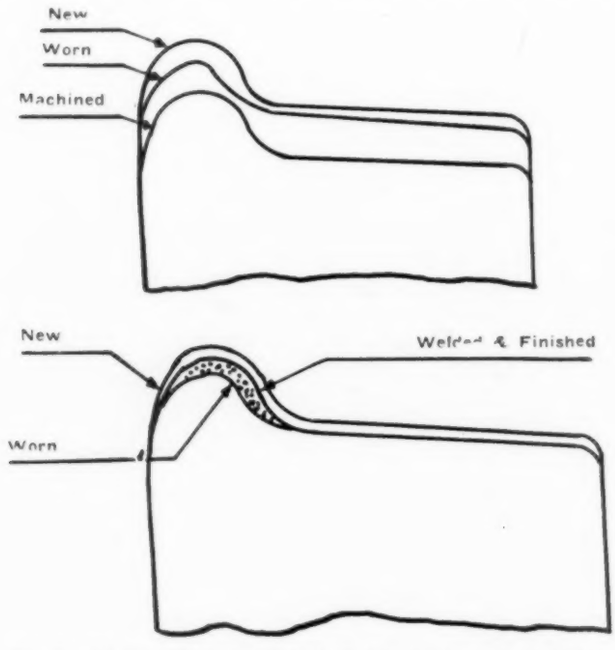


Fig. 2. (Above) Thirty-three-inch Rolled Steel Wheel Showing Preparation for Welding. Fig. 2 A (Below) Contour After Being Welded.

That this work is economical is evidenced by the fact that a number of mining properties have welded hundreds of such tires. In one instance the work is carried on as follows: A 26-inch diameter tire worn $\frac{3}{16}$ inch deep by 2½ inches wide is built up with 26 beads of weld metal in two layers rotating the wheels at a peripheral speed of 11 inches per minute. The actual cost of welding is $7.00 and the time for machining is 2½ hours. Each tire new costs $34.00. In addition, there would be a charge for pressing off the old tire and pressing on the new tire. There is, therefore, a very nice saving in favor of the welding operation.

More Organizations to Participate in National Metal Congress

The Machine Shop Practice Division of the American Society of Mechanical Engineers under the chairmanship of F. C. Spencer of the Western Electric Company at Kearny, N. J., have voted unanimously to transfer the program which they had previously planned to hold at the Machine Tool Show in Cleveland to the National Metal Congress at Buffalo, the week of October 3.

In addition to the Machine Shop Practice sessions of the A. S. M. E. the program which had been planned by the Society of Automotive Engineers to be held in Cleveland, has also been transferred to Buffalo.

The combination of these two societies in machinery

and machine shop practice will present an outstanding program of particular interest to production men and superintendents.

In addition to the acquisition of the two other technical societies which have transferred their programs to Buffalo, definite arrangements have been made by Charles Smith, president of the American Drop Forging Institute to hold the meetings of the Institute at Buffalo during the National Metal Congress.

The Institute has two meetings a year, one at which the executives meet and the other at which not only the executives but the industrial and technical men from the forging plants assemble for the discussion of important problems dealing with their particular branch of the industry.

It is this meeting of the technical and engineering forging men which will be held in Buffalo, and several sessions are being arranged of particular interest to forging men. This is the first time that the Institute with its technical men has been affiliated with the Congress.

Lincoln Competition Prize Awards

IN peace as well as war the navy cooperates and competes with the army. This was demonstrated when Lt. Com. Homer N. Wallin, U.S.N., and Lt. Henry A. Schade, U.S.N. working in collaboration on the paper submitted won first prize in the Second Lincoln Arc Welding Prize Competition sponsored by The Lincoln Electric Company of Cleveland, Ohio. Second prize was won by Major G. M. Barnes, U.S.A.

A resume of the savings to be effected by using arc welding extensively in all industries as shown by approximately 400 papers submitted in the competition shows an estimated saving to industry of almost a billion dollars a year, provided the process was used as extensively as possible.

The jury, under the direction of Prof. E. E. Dreese of Ohio State University, awarded first prize of $7500 to the two naval officers who submitted the prize winning paper. Both officers were members of the Construction Corps at the Navy Yard, Mare Island, California, but Lt. Schade has since been transferred to Washington. The title of their paper is "The Design and Construction of an Arc Welded Naval Auxiliary Vessel."

Major G. M. Barnes, U.S.A., Chief of Design and Engineering, Ordnance Department, Watertown (Mass.) Arsenal, won second prize of $3500. For his paper "Manufacture of Ordnance at Watertown Arsenal Revolutionized Through Arc Welding."

"The Application of Arc Welding to the Design of Steel Buildings for the Resistance of Earthquake Forces" won third prize of $1500 for H. H. Tracy, Structural Engineer of the Southern California Edison Company, Ltd., of Los Angeles.

A $750 fourth award went to Gustav F. D. Wahl and Harry E. Johns, Kiel, Germany, for a paper on a special river-sea bulk cargo ship. H. J. L. Bruff of Harrowgate, England, won fifth prize of $500 for "Strengthening Weak Iron and Steel Bridges by Arc Welding." A paper on arc welding steel cars won $250 for William H. Zorn of Wyandotte, Michigan. Thirty-five additional prizes of $100 were awarded to writers of papers which showed the application of and savings possible by arc welding in every industry.

The first prize winning paper describes the construction of an arc welded auxiliary vessel for use with the fleet at San Pedro. The hull is conventional ship-shape in form

Lt. Commander Homer N. Wallin and Lt. Henry A. Schade, Winners of First Prize. In the Background is the Arc Welded Vessel Described in Their Paper.

J. C. Lincoln, Treasurer of the Lincoln Electric Company, "Signing" the First of Three Prize Winning Checks.

and is 118 ft. long, with a full load displacement of 300 tons. Speed of the craft is 10 knots.

Arc welding has been in use by the navy since 1917 when sabotaged engines of seized German liners were repaired by this process. Since displacements of naval vessels have been limited by international treaties the navy has begun to look upon arc welding as a standard method

Check for the First Prize. This is the First Ever Written on Steel with the Electric Arc.

of construction. The process is supplanting riveting over a wide range of applications in increasing amounts on each new ship, as it becomes more and more evident that lighter structures of equivalent strength, rigidity and shock resistance may be obtained by welding.

In addition to the partial use of arc welding on large ships the navy has substituted welding completely for riveting on a considerable number of smaller ships. The welded vessel was built at a 10% saving over riveted construction. In addition a riveted ship of the same size, being 17% heavier, has a correspondingly reduced carrying capacity. The welded ship therefore yields greater service for a smaller investment. The total savings, direct and indirect during the lifetime of the arc welded vessel, will be enormous and out of all proportion to the savings in first cost.

Arc welding had never been used in the construction of gun carriages until the 3" anti-aircraft mount (mobile) described in Major Barnes' paper was built. This piece of ordnance was selected because, in addition to being the most modern type of post war carriage standardized by the army, it was subjected to severe road tests in addition to the impact forces due to firing. The principal parts of the carriage are highly stressed and of intricate design.

The substitution of welded steel members for castings in the piece of ordnance described by Major Barnes has shown such decided advantages in strength, weight saved and lower costs that it has brought about the adoption of welding as an approved method of manufacture for ordnance structures.

The tremendous savings and improved design of the ordnance structures mentioned here are typical of the results which can and are being secured in every industry utilizing iron and steel by the use of arc welding. Other papers submitted in the competition point out these savings.

Mr. Tracy's paper on arc welded steel buildings to resist earthquake shocks deals with the construction of a thirteen story general office building of the Southern California Edison Company, Ltd., at Los Angeles. By the application of arc welded construction the structure will resist seismic shocks of an intensity comparable to those which would be produced by a disturbance similar to the San Francisco earthquake of 1906 or the Tokyo earthquake of 1923.

Ideas, research findings and welding techniques advanced in the papers submitted indicate that arc welding is playing an increasingly important part in industry every year. Prize papers will be published in book form.

The first three prize winners received what are believed to be the most unusual checks ever issued. These three checks represented first, second and third prizes in the prize competition.

The checks, for $7500, $3500 and $1500 respectively, were "written" on ⅛" sheet steel. Each check was 24 inches long and 10 inches wide.

Welding operators in the Lincoln plant relieved the treasurer's office of the detail of filling out the checks. All information, including date, amount, payee and the name of the bank was arc welded. The checks were signed by the arc welding process. The photograph shows J. C. Lincoln affixing his signature. A close up view of the $7500 first prize check is also shown.

The prize winners will endorse the checks by the same novel method and when the panels of steel are presented to the banks and paid, they will be returned to the bank of issue, where guards will cancel them with the aid of a sub-machine gun.

PRIZE AWARDS

First to Sixth Prize Winners

Paper No.	Name	Subject	Prize	Amount
216	Lt. Com. Homer N. Wallin and Lt. Henry A. Schade, Construction Corps, U. S. N. Navy Yard, Mare Island, Calif.	The Design and Construction of an Arc Welded Naval Auxiliary Vessel	1st	$7500
229	Major G. M. Barnes, Ordnance Dept., War Department, Watertown Arsenal, Watertown, Mass.	Manufacture of Ordnance at Watertown Arsenal Revolutionized through Arc Welding	2nd	3500
97	H. H. Tracy, Structural Engineer, Southern Calif. Edison Co., Los Angeles, Calif.	The Application of Arc Welding to the Design of Steel Buildings for the Resistance of Earthquake Forces	3rd	1500
230	Gustav F. D. Wahl, Chief Naval Arch. and Harry E. Johns, Consulting Engineer, Deutsche Werke Kiel, Aktrengesellschaft, Kiel Germany.	Special River - Sea Bulk-Cargo Ship	4th	75
264	H. J. L. Bruff, (Bridge Asst.) London & North Eastern Ry. Kell House, Greenhow Hills, Harrogate, Yorks, England.	Strengthening of Weak Iron and Steel Bridges by Means of Arc Welding	5th	50
165	William H. Zorn, 464 Superior Blvd., Wyandotte, Mich., (Detroit Edison Co.)	Arc Welding of Steel Cars	6th	25

Seventh to Forty-First Prize Winners

Paper No.	Name	Subject	Amount
14	Dr. Eng. L. Kuchel, Berlin, Halensee, Germany of C. D. Magirus Co., Ulm. Ger.	Motorized Fire Escapes	$10
27	Gilbert C. Coombs, 4144 Eierman Ave., Baltimore, Md., (Mexican Petroleum Corp.)	Welded Steel Expansion Joint	10
57	Raymond S. Hoffman, P. O. Box 16, Elizabeth, N. J. (Mech. Supt. Bayway Refinery, Standard Oil Co. of N. J.)	Welded Alloys to Arrest Corrosion	10
58	James Winston, 15 Clark St., Summit, N. J. (Chief Engr. Elizabeth Iron Works, Inc., Elizabeth, N. J.)	Arc Welded Stair Railing	10
61	D. L. Pellett, Designing Engineer, Champion Coated Paper Co., Hamilton, Ohio.	Arc Welded Pebble Mills	10
67	Cletus F. Fox, 64 Hastings Ave., Buffalo, N. Y. (Mech. Designer, Ross Heater & Mfg. Co., Buffalo, N. Y.)	Welded Surface Condensers for Land Use	10
73	W. G. Theisinger, 8 Cambridge Place, Brooklyn, N. Y. (Board of Transportation, City of N.Y.)	New York Subway Construction	10

(Continued on Page 51)

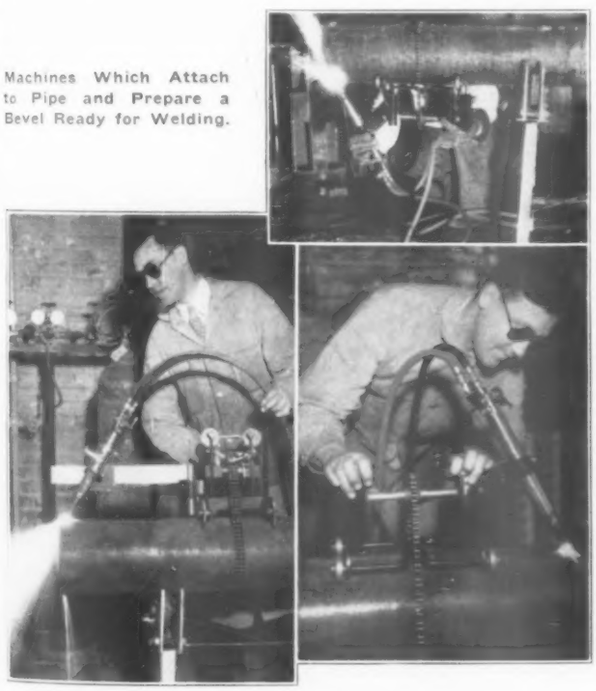
Low Costs Made Lower

Modernizing for Profit

Mechanical control of cutting torches adds to the economies that are effected when pipe installations are welded. The smoother, more accurate cuts obtained by machine methods reduce the welding costs and favor better workmanship. Equipment is already available for a wide range of work.

NOT completely satisfied with the economies realized in the early years of application of oxy-acetylene welding to joining of pipe, both in buildings and for long pipe lines, engineers interested in this application have worked continually to arrive at still further economies without sacrificing the quality advantages which are found in welded lines. One department of the welded pipe fabrication in which there is considerable promise of improvements and economies as a result of engineering research is that of cutting the pipe. The need for a device or machine that would cut off and bevel steel and wrought iron pipe has been apparent for many years. Pipe lathes used for beveling pipe are not adapted to work on short lengths of pipe. They often make an eccentric bevel, leaving a heavy shoulder on one side and making necessary the use of a reamer to remove the distorted metal and burr from the inside of the pipe. Torch beveling by hand also has some inherent defects and generally involves at least two and sometimes three operations. Usually, the pipe is marked, then cut off square with the torch, the tip being held at right angles to the surface. The pipe is then beveled with the torch, held at an angle to the surface. The beveled edge must then be cleaned of slag and scale.

While it is true that the cutting torch used in conjunction with the welding torch make up a combination which results in a very economical pipe line fabrication as compared to the use of mechnical joints, there is no reason why this combination process should not be made still more economical if possible. Anyone familiar with oxy-acetylene cutting machines knows that machine cutting has distinct advantages over hand cutting, both in the matter of cost and in the quality of the cut. This has suggested the development of mechanically operated cutting torches especially adapted for work on pipe for welded lines.



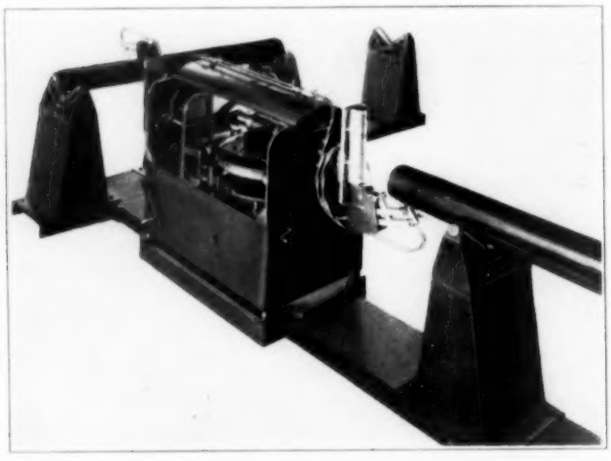
Machines Which Attach to Pipe and Prepare a Bevel Ready for Welding.

Two ingenious machines have been developed by the Engineering Department of the Air Reduction Sales Company for cutting pipe to any length and eliminating some of the difficulties encountered by former methods of cutting. One of these is a gear driven machine which will cut pipe ends square and smooth and straight or to any desired bevel, leaving the edges free from slag, and accomplishing the cuts with a minimum of expense for time and gases. This gear driven machine is normally equipped to cut 4, 6, 8, 10 and 12-inch pipe, but can be fitted with longer chains to cut pipe up to 30 inches in diameter. The chains have slip links marked at intervals so that it can be separated to secure the correct lengths for each size of pipe indicated. The machine may be rotated about the pipe if the pipe is stationary, or if the pipe can rotate, the machine can be held fixed and the pipe turned. The driving control of this machine results in a uniform speed of the control movement which produces a cut comparable to the machine cuts obtained on plate stock. The mechine is designed to make true, clean cuts on new or old pipe. When the bevel end with a shoulder is desired, this can be obtained by beveling to a feather edge and knocking off about $\frac{1}{16}$ inch from the feather edge with a rough file. The filing operation takes but a few strokes and is considerably faster and more economical than the procedure of making two cuts and cleaning off the slag.

A particularly advantageous application of this machine is found in cases where it is desired to cut out couplings from a threaded line or to cut out defective welds from a welded line. In this case two torches can be mounted on a machine so that two cuts are made simultaneously.

Where the amount of cutting is not so large and continuous, there is evidently a field for a lighter machine for small amounts of intermittent cutting where extreme accuracy of cut is not of great importance. The Airco D-B hand operated pipe cutting and beveling machine was designed to take care of this field of work. It is used in the reclamation of old screw joint lines, in cutting pipe for small installations, in junk yards, etc. The hand operated machine is based on the same principle as the gear driven machine—that is, the use of a chain to hold the machine to the pipe and to guide it around the pipe. The essential difference between them is in the method

of propulsion. The large machine employs a crank operating through a worm and spur gear to turn the chain sprocket and thus move the machine around the pipe. The small machine is pushed around the pipe by hand. Both machines will produce cuts the plane of which is square with respect to the center line of the pipe. The



Douglass Pipe Fitting Machine for Shop Preparation of a Varied Line of Connections.

small machine has only three adjustments for bevels, namely, 90 degrees, 45 degrees and 30 degrees. The illustrations show these two types of machines in operation. The actual torch adjustment and machine cutting proceeds as with any of the conventional machine cutting operations. If the pipe is fixed in a trench, the machine is rotated around the pipe, and if the pipe is free to rotate, the machine is kept on the upper section of the pipe as it revolves. A number of these machines has already been placed in different localities for various periods of service and are reported to have made an excellent showing. They are therefore being recommended for plumbers, steamfitters, pipe line contractors, junk yards and others who have occasion to cut pipe for any purpose.

Another example of the application of the principles of mechanical torch cutting to pipe fabrication is the Douglass pipe fitting machine which has previously been mentioned in these columns. This machine is made especially for shop work where there is a considerable volume of cutting for the fabrication of ells, elbows, closed ends, tees, branches and headers. The mechanical problems involved in making cuts for these purposes are obviously more complicated, and consequently the machine developed for this kind of work is more elaborate. In the Douglass machine the mechanical movement of the cutting torch is a combined rotating longitudinal and angular motion which produces in one operation cuts of the correct shape and proper bevel. No templets or patterns are needed, as the required templet for any cut is generated in the machine itself by making two simple adjustments. The pipe standards are of fixed height and the cutting machine is quickly raised or lowered to suit the size of pipe cut. The pipe comes from the machine with the cuts clean, free from scale and oxide and ready for welding.

Altogether, the three machines described take care of a considerable range of requirements for pipe cutting.

There is not yet available a complete collection of figures to indicate the range of savings in gas and labor by the use of all of the equipment described. Some experiments have been made with the Douglass pipe fitting machine to get an indication of the possibility in this direction, and some of the data from these experiments will be quoted below to show that definite savings may be expected.

One experiment conducted was the construction of three 3-piece ells in 4, 6 and 8-inch pipe, respectively. When hand cutting with templets was used, there were obviously six cuts required for each ell—two square cuts and four bevels. The total cost including layout time, cutting time, material and labor was $1.57 on the 4-inch pipe, $1.85 on the 6-inch pipe, and $2.33 on the 8-inch pipe.

When the machine was used, the number of cuts was reduced from six to four. The total cost for cutting the ells was 74 cents for the 4-inch pipe, $1.00 for the 6-inch pipe, and $1.22 for the 8-inch pipe.

A second experiment was made in the fabrication of an experimental header, using for the main pipe an 8-inch standard steel pipe with branches of 8, 6 and 4 inches, respectively. Templets were used for laying out the cuts and the cuts were all made by hand. Separate records were kept for each of the connections, and it was found that in the case of the hand cutting, the total cost of cutting the 4-inch branch was 59 cents; total cost of cutting the 6-inch branch, 68 cents; and the total cost of cutting the 8-inch branch, 96 cents. This included cutting the holes in the header and cutting the end of the branches to fit these holes.

In comparison with these costs, the same cuts were made on the machine resulting in a total cost of cutting the 4-inch branch of 31 cents; the 6-inch branch, 41 cents; and the 8-inch branch, 67 cents.

It has been considered that the smoothness of cut has an effect on the ease and economy of welding fabricated by connections, and in order to check this theory, the connections cut out in the course of the above experiments were welded and records kept of the operating cost, with the following results:

In the case of the 3-piece ells cut by hand, the welding cost including labor and materials was $3.11 for the 4-inch pipe, $4.52 for the 6-inch pipe, and $6.55 for the 8-inch pipe. The costs of welding the ells cut out by the machine were as follows: $2.31 for the 4-inch pipe, $4.10 for the 6-inch pipe, and $4.75 for the 8-inch pipe.

TABLE I

Savings on Three Piece Ells

Cutting			Welding			Complete Fabrication		
4"	$0.83	52%	4"	$0.80	25%	4"	$1.63	34%
6"	.85	41%	6"	.42	9%	6"	1.27	20%
8"	1.11	48%	8"	1.83	28%	8"	2.94	33%

Savings on Branch Connections

Cutting			Welding			Complete Fabrication		
4"	$0.28	47%	4"	$1.04	43%	4"	$1.32	44%
6"	.27	40%	6"	.67	22%	6"	.94	25%
8"	.29	30%	8"	1.12	29%	8"	1.41	29%

Savings on 3-Branch Header

Cutting		Welding		Complete Fabrication	
$0.84	38%	$2.83	30%	$3.67	32%

Similar experiments were made in the welding of the header connections cut out in the course of the second experiment, and welding data obtained shows the cost of welding the hand cut connections as follows: 4-inch

(Continued to page 44.)

This Modern Piece of Equipment is Made by Modern Methods. Heavy Plate is Shaped by the Mechanical Cutting Torch and Structured Together with the Arc.

Fabrication in the Large Welding Plant

By A. M. McFarland†

"Custom-built" may mean luxury in an automobile, but in plant and factory equipment it more often means economy. A capable welding organization can fabricate parts exactly to individual requirements at huge savings compared to the cost of making patterns and special castings.

THE completely equipped welding shop rarely depends upon repair work for all of its business, but naturally turns to production and special fabrication to increase its volume. Such work is usually solicited from plants having a knowledge of welding and possibly a welding crew, but lacking the personnel necessary for planning and executing the welded fabrication of important structures. The jobs to be described require good engineering control as well as proper plant facilities if they are to be successful and economical. They were all made by the Youngstown Welding and Engineering Company, Youngstown, Ohio.

Figure 1 is a fabricated turbine shell, and cover formed from flat plate, cut to shape by the acetylene torch, shaped under a hydraulic press, and welded. The top plate for the turbine shell is shown in Figure 2. This is made from a single piece of 2" manganese, 40% carbon steel plate, cut with the mechanically controlled cutting torch. The width is about five feet. It was welded with a heavily coated rod assuring a "shielded arc" with good ductility in the weld. After the job was welded, the shells were annealed or normalized by heating to a temperature of about 1200 degrees F. and holding at that temperature for about two hours and allowed to cool in the furnace. Warping and distortion was avoided by the "skip-back" system of welding.

The gear case cover here shown in the heading illustration stands about six feet high and is made of heavy plate cut to shape by acetylene torch and electric arc welded. Distortion was avoided by using the "skip-back" system of welding, carrying the two sides along together. The heavy lifting hooks were cut to shape from plate about 1½" thick, as were also the stiffening ribs. Care was given to making fillets and contours neat and well rounded, to present a finished appearance. The name that appears on the side is composed of letters cut by the automatic cutting torch from ½" plate, welded on.

The worm-gear housing shown in Figure 3 is combined with a base-plate for mounting the driving motor and was designed to avoid weight, so far as was consistent

†*Welding Engineer, Youngstown Welding and Engineering Company, Youngstown, Ohio.*

with the necessary stiffness and strength. The base plate is bent up from flat plate under the hydraulic press shown in the left background of the picture. The curved contours of the main housing were formed in the same way, rough forming dies having been previously prepared.

After some years of experience with such jobs, the shop has accumulated a stock of bending dies that may be used over and over again for forming the ordinary run of curves and corners. The flat plates were clamped down to a heavy cast iron platen while being welded, avoiding any serious distortion. The hydraulic press was used to straighten out such warping as was unavoidable, and the job given a final annealing to relieve shrinkage strains that might cause warping when the job was machined. A bonus of ten cents per pound was paid by the customer for all weight saved over the designer's estimate.

A marine type of ball bearing winch built by this company from all-welded design is shown in Figs. 4 and 5. In this design, weight is an important factor. Care has been taken to preserve a neat appearance by making symmetrical contours and rounded corners. The base is formed from plate with turned down edges, the corners being rounded and welded, following the usual cast iron design, but saving a large percentage on weight. The drums are made from flat plate rolled up to cylinder form and flanged. The gears are entirely fabricated from flat plate. The rims of manganese carbon steel are rolled up to shape, and vee welded with a coated rod adapted to the work. To facilitate filling in the heavy vee, side plates of ¼" soft steel plate were clamped to the sides, covering the ends of the vee, making a pocket that could be puddled full, without trouble from the metal running down the sides. These side plates were welded in as a part of the fill, and later cut off in the shaper. This method assures a finished job on the sides of the weld, and avoids unsightly blow-holes and rough finish that so often appears on the side of a fill of this kind. (Fig 5-a.)

The gear centers were made from flat plate, cut to shape by acetylene torch, with hub plates welded on. As the building up of the case progressed, frequent surveys were made to check for warping, and any distortion was straightened out under the press as soon as it appeared, avoiding accumulated error from this source. Final annealing insured against distortion when machining.

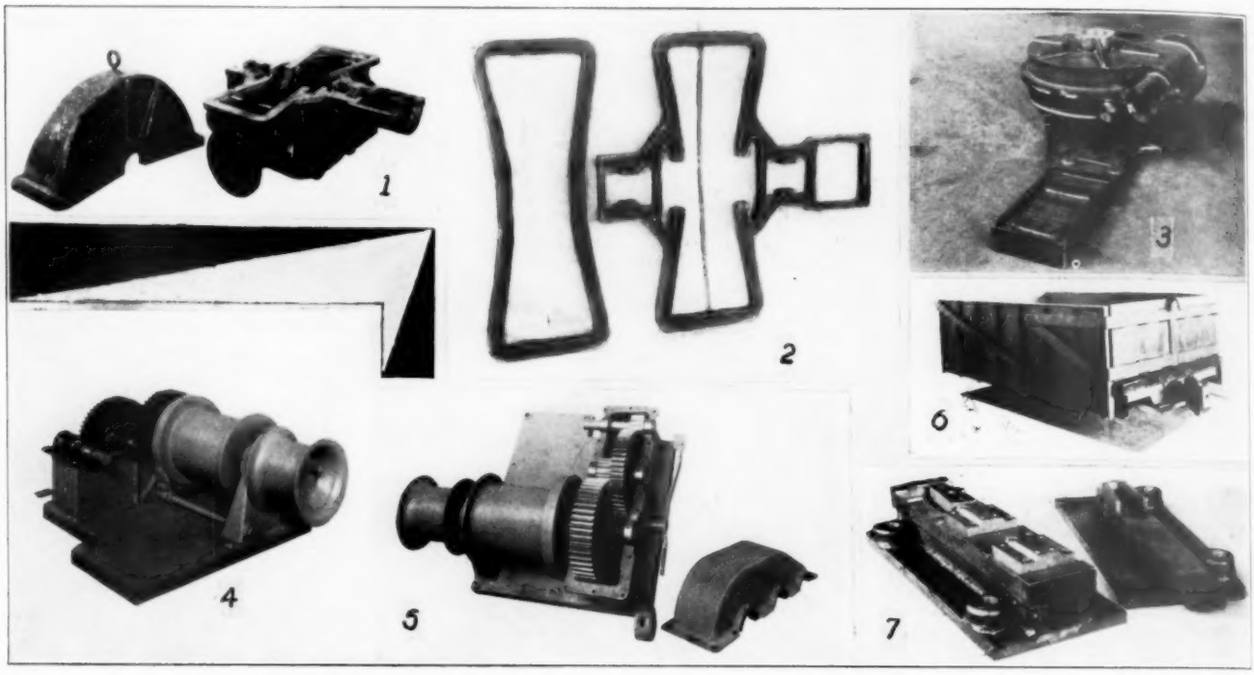


Figure 1. Turbine Shell Fabricated by Welding. Top Plate is Shown in Figure 2. Worm Gear and Base Plate (Figure 3) Designed to Save Weight. Figures 4 and 5. Marine Type Winch Entirely Fabricated of Plate. Figure 6. Industrial Dump Car in Which Rivets are Entirely Eliminated. Figure 7. Heavy Forming Die Which Presents an Unusual Welding Problem.

Figure 6 shows an industrial dump car designed for mine use. The usual riveted construction is entirely replaced by welding, effecting a saving of some 20% over the riveted design and making a stronger car. Special attention was given to making the welds of ample cross section, and having all tack welds oppositely placed, to avoid concentration of bending stresses in the welds. Experience has shown that the rough usage to which such a car is subjected will weave and bend it in all directions, and the welds must be so designed and made as to maintain their rigidity under working conditions.

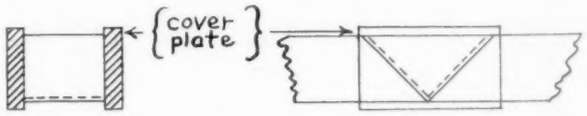


Figure 5-A. Plates Used to Give Good Appearance to End of Weld.

Figure 7 is a heavy forming die built up by welding. A job of this kind, made from 4 and 5-in. plate, presents several problems not met with in the lighter kinds of welded construction. When a light bead is welded on such heavy cold plate, the quick cooling will tend to crack the weld. Either extra heavy welding current must be used, or the weld built up in one place until the heat has spread locally enough to avoid sudden cooling when the arc is removed.

Containers and tanks offer an endless variety of opportunities, especially for the larger shops capable of making their own equipment at low cost. Figure 8 is a direct fired cylindrical furnace, built up entirely by welding. The

double walled shell is to be fitted with a fire brick lining. The welded construction saves about 20 lbs. in weight and there is no templet and punching work involved, as would be the case with a riveted job. Gas welding a large transformer tank is shown in Figure 9. Gas welding on these comparatively thin shells is simple and an average operator will make a tight job without any special effort. Up to a few years ago, it was almost universal practice to gas weld such tanks. However, in recent years, many shops have been electric welding them, claiming that the electric process is faster and cheaper, and that once their operators are trained to it, they have little difficulty in making it tight.

The problem of electric welding thin shells is much simplified by the use of coated rods that are now available. The flux steadies the arc, and even where light currents are employed, there is not much trouble with losing the arc. Some shops are using currents of less than 50 amperes on 20 and 22 gauge stock with satisfactory results.

Figure 10 shows a hydraulic press of 250 tons capacity, built up from flat plate stock by welding. It was made by a welding shop for bending and forming all kinds of welded construction. The pump was also designed and built in the shop. An automobile crank shaft and parts were used and the remainder of the outfit fabricated and welded. The water line carries a pressure of 2600 lbs. per square inch, the two press cylinders working in parallel. A heavy accumulator completes the unit. The single cylinder press shown in Figure 10-B is of similar construction, and is used for the lighter class of work. It has a capacity of 150 tons, and is one of the most indispensable tools in the shop.

Figures 11 and 12 show two types of furnace built in large quantities by this shop. One interesting problem in connection with furnace welding develops when the weld occurs at a point where it meets the impact of hot gases, either in a coal or gas fired furnace. The ordinary electric arc weld is quickly eaten away, not having nearly as much resistance to this action as the original plate. A study of conditions shows that the welds that failed to stand up were apparently good, sound, commercial welds, but on microscopic examination showed a network of oxides and nitrides framing the crystals. Such welds when given an acid test showed a porous and roughened surface. It was evident that the hot gases dissolved out the nitrides and oxides and opened up the porous structure, allowing the corrosive gas to attack the interior of the structure, which soon crumbled. The cure was found to be the use of a good type of heavily coated rod, which gave a "shielded arc" and avoided the formation of nitrides and oxides. If the weld would stand the acid test without roughened surface, it would also stand up against gas attack, at least as well as the plate itself. If the gas conditions are very severe, it is best to build up a coating of manganese steel or some similar corrosion resisting material.

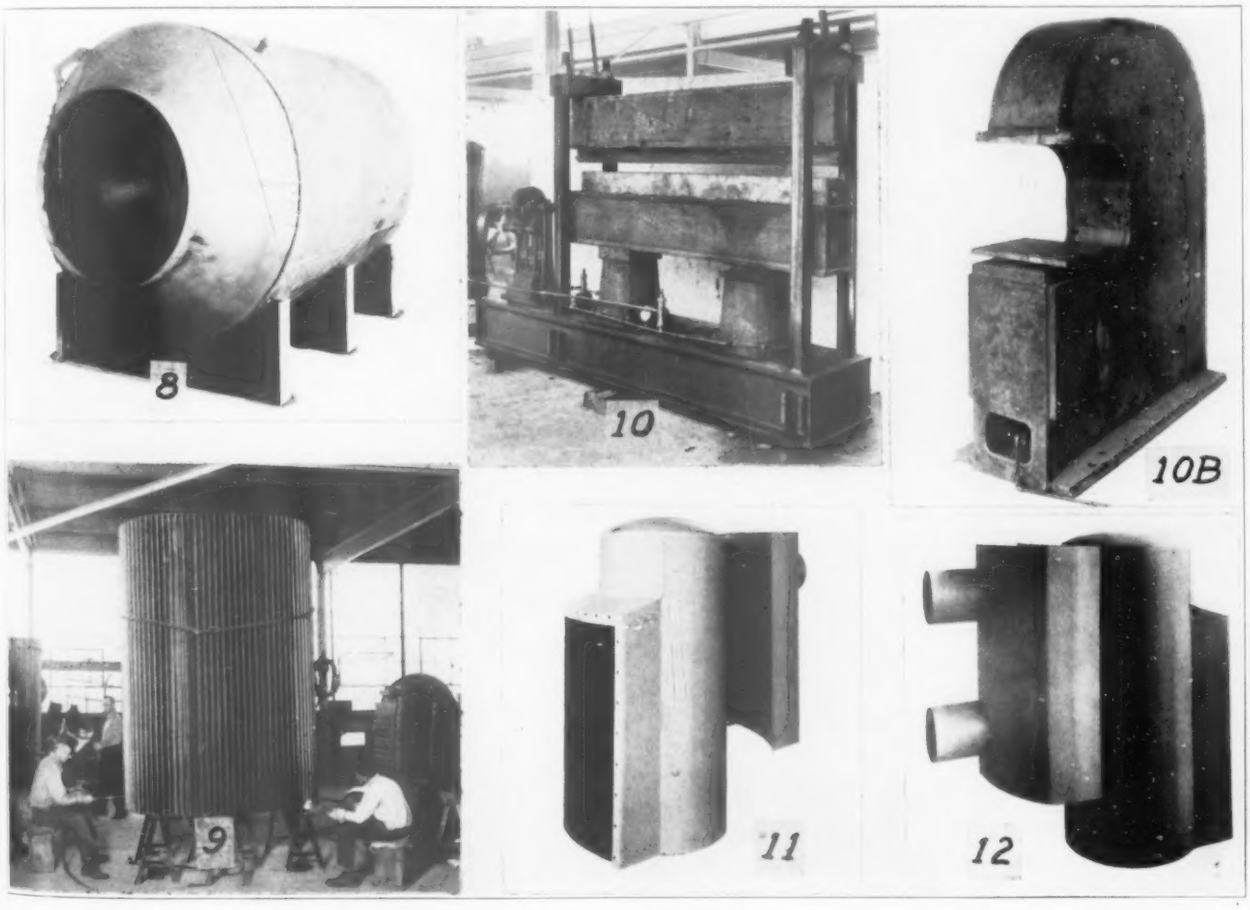


Figure 8. Direct Fired Cylindrical Furnace Welded with Saving in Weight. Figure 9. Gas Welding a Large Transformer Tank. Figure 10. Two Hundred Fifty-Ton Hydraulic Press Entirely Fabricated in the Welding Shop. Figure 10-B. A Similar Press of 150-Ton Capacity. Figures 11 and 12. Two Types of Furnace Built on a Production Basis.

Classification of Locomotive Cylinder Welds*

By J. C. Miller†

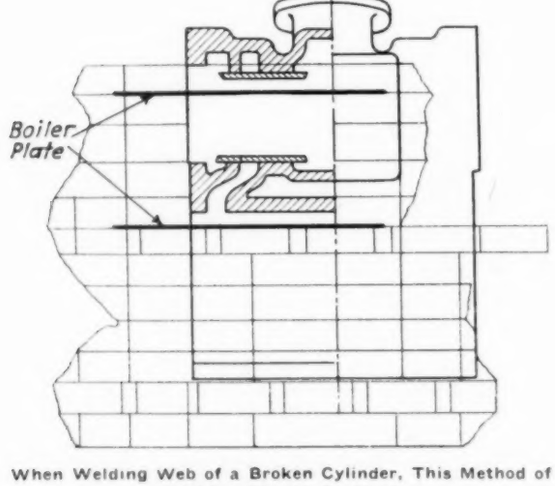
The broken locomotive cylinder is an excellent basis for study of problems involved in the welding of large iron castings. Each job is different, yet each one must be finished with precision. When properly done the cost is only a small fraction of the price of a new casting.

A GAS welding process of major importance at the Conneaut shops of the Nickel Plate Road is the welding of broken cylinders. This operation may be divided into two classes, with sub-divisions as shown below:

1. Cylinders *not* removed from the frames.
   (a) Front of cylinders damaged by water blow.
   (b) Cylinders and valve chambers cracked longitudinally.
   (c) Valve chambers cracked circumferentially.
   (d) Cylinder and valve head joints built up.
   (e) Oversize cylinder and valve chamber studs welded up.
2. Cylinders removed from frames.
   (a) Cylinders cracked in frame fit.
   (b) Cylinders cracked in saddle.

In all the cases referred to above the cylinders are preheated, the extent of which, however, depends on the nature of the fracture to be repaired.

When building up defective cylinder or valve chamber head joints the preheating may be accomplished by placing



When Welding Web of a Broken Cylinder, This Method of Bricking Should Be Used.

a grate of front end netting half way up from the bottom of the cylinder of valve chamber and building a charcoal fire thereon. The outside of the cylinder must be covered with heavy asbestos paper to retain the heat developed and to prevent cold air from coming into contact with the heated cylinders. The balance of the various classes of fractures, in our opinion, should always have a brick furnace built around the cylinder. In this case a grate of front end netting is placed across the furnace wall about 6 inches below the bottom of the cylinder in addition to the front end netting grates placed within the cylinder and valve chamber. When building the furnace, care must be taken to lay the two bottom rows of bricks with 1 in. openings between the ends in order to create the required draft. When the furnace and grate arrangement is completed, charcoal is placed on the grates and the fire started. Care must be exercised to have a slow burning fire in order to raise the temperature of all sections together which would not result in case the fire was forced at the start.

Making Proper Preparation

When preparing to weld a fractured cylinder which has not been removed from the locomotive and which has a brick furnace built around it, we find it is a very good rule not to start the welding until the temperature of the cylinder saddle adjacent to the flange has reached a temperature which will not permit the hand to be placed comfortably thereon.

In the case of the welding of a cylinder fracture when the cylinder has been removed from the frame the furnace is built entirely around the cylinder. The grate arrangement is the same as previously described. The top of the furnace around the cylinder is covered with several layers of heavy asbestos paper.

In the construction of furnaces around the cylinders it must be thoroughly understood that the construction be such as to permit easy removal of sections to afford access to the fracture. At the point above the base of the furnace where begins the section of brick which it is desired to remove, a strip of sheet iron is placed on top of the bricks. The furnace sides are continued upwards, leaving an opening of sufficient width to permit access to the fracture. When the desired height of opening is reached a strip of heavy metal is placed on top of the bricks to support the upper rows of bricks used in completing the furnace. The

*From a paper read before the 32nd annual convention—International Acetylene Association, Chicago, Illinois—November 11, 12, 13, 1931.

†Superintendent of Shops, The New York, Chicago and St. Louis Railroad Company, Cleveland, Ohio.

opening thus provided is then bricked in with bricks laid with straight joints which permit easy removal.

While the welding is performed it is necessary to replenish the fire from time to time as the occasion may demand in order to maintain the desired temperature. When the weld has been completed the furnace must again be fired up and completely covered with asbestos paper and allowed to cool to room temperature before the asbestos paper and brick are removed.

When building up cylinder or valve chamber head joints it is our practice to use bronze. Likewise when building up oversize stud holes prior to drilling and tapping standard. The balance of cylinder fractures, with one exception, are welded with cast iron. The one exception is the case where the portion of the cylinder which rests on the frame rail has been so badly broken that it is necessary to replace the broken pieces with a piece of steel plate. In this case bronze is used as the cast iron welding rod would not make a satisfactory bond between the steel plate and the cast iron.

When repairing fractured cylinders with either bronze or cast iron we have never had a failure since we adopted gas welding on cylinder reclamation. We believe the secret of our success lies in the care we exercise in the preparatory work. Of course, we appreciate that it is necessary to have experienced, skillful operators and last but not least good material.

Making Savings of 75 to 90%

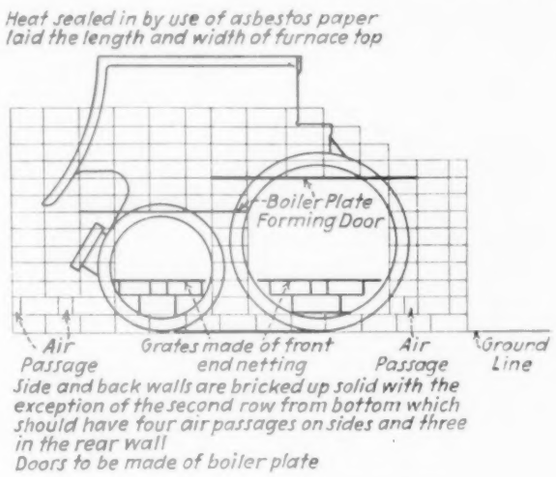
Considering the saving effected by the gas welding process I will say that carefully compiled reclamation costs on a pair of cylinders removed from the engine showed that the cost of reclamation was only 25% of the cost of new cylinders. It might be interesting to know that this work was performed about three years ago and that no trouble whatever has been experienced with the cylinders to date. Cylinder reclamation, in the case where the cylinders were not removed, can be accomplished for approximately 10% of the cost of new cylinders. However, it must be thoroughly understood that the nature of the fracture governs the reclamation cost. Cases may arise where the nature of the fracture is so serious as to result in a heavy reclamation expense. It must be understood that the determining factor as to whether or not the cylinders must be removed is the location of the fracture.

The Uses of Bronze

Another major operation consists in building up worn sides of guides. It is one of our shop practices to maintain the dimension of our guides standard. When removed from the engines the guides are first straightened. They are then freed from all scale and foreign matter in order that they have a clean surface. In the building up process one operator preheats the guide, working just ahead of the second operator who applies the manganese bronze. Manganese bronze is used in this case account of its wear resisting properties which would not be the case if Tobin bronze is used. With the aid of this process we are able to build up a set of four guides in approximately two hours. Contrast this time interval, if you will, with the old practice of patch bolting strips of metal to the sides of guides which required approximately twenty hours to one set of four guides.

We also maintain our motion work parts standard so far as lateral is concerned by the application of manganese bronze to the wearing surfaces. In the past the worn end of the part fitting into the clevis was made sufficiently thick by blacksmith welding a piece on each side and machining so that the lateral motion in the clevis was thus taken up. We know that it is 60 to 75% more economical to build up both the clevis and the part fitting into it by gas welding and then machining both to standard dimensions.

Stoker screws wear rapidly when in use and often have to have the flights built up to standard dimensions in order that they can properly transfer the coal. Some time ago a brand of welding rod was furnished which may be applied either by gas welding or the electric arc. This welding rod when applied presents such a hard surface that it cannot be machined. We found that when this rod was applied with the electric arc that our operators could not produce a smooth surface which made it necessary to grind the outside edges of the flight. We then investigated the possibilities of applying the rod with the aid of the acetylene torch. It was found that our operators could produce a welded surface which required no grinding. While we do not know the length of life we may obtain we know that the service already obtained is such that the additional cost of applying the rod with the acetylene torch as compared with the electric arc is, at least, offset.


Heat sealed in by use of asbestos paper laid the length and width of furnace top
Boiler Plate Forming Door
Air Passage
Grates made of front end netting
Air Passage
Ground Line
Side and back walls are bricked up solid with the exception of the second row from bottom which should have four air passages on sides and three in the rear wall
Doors to be made of boiler plate

Typical Firebrick Welding Furnace.

Control of Expansion in Copper Plate Welding*

THE work described was done in one of the oldest established in England, and they, with typical British conservatism, were prejudiced against welding for some considerable time after their competitors had changed over to this more practical process. They probably had their justification in the fact that most of their vats were made of copper, which, up till recently, bore a notoriously bad reputation as far as welding was concerned. At length, however, the directors of this brewery could not fail to see that their competitors, while keeping up to their former high standard of purity of product, were cutting their production and maintenance costs, and consequently reducing their selling price to the public.

The engineers in charge of the brewery machinery were asked to fabricate, by oxy-acetylene welding, eighteen

*From an article in the "Mechanical and Welding Engineer," Official Organ of the Australian Welding Institute.
†Member, Australian Welding Institute.

vats from $\frac{3}{16}$-inch copper plate. They had not had much experience in the welding of copper and consequently they were not confident that the results would be successful.

These vats, 6 ft. 4 in. dia., and 8 ft. 6 in. in height, were to be fitted with dished ends, bolted on, and were designed to withstand a working pressure of 25 lbs. per square inch, to be tested to 40 lbs. water pressure.

They are fitted with flanges for the purpose of securing pipe lines and gauges and in the side of each provision is made for a manhole. Under the old methods of construction, these tanks were made from $\frac{3}{16}$-in. copper plate, rolled to shape, lapped, and then riveted. It is obvious that the liquid contained in such vats would have every opportunity to corrode the plate in this form of joint. Again, as copper is a fairly expensive metal, it is uneconomical to lap the joints, as a considerable amount of surplus metal is thus used.

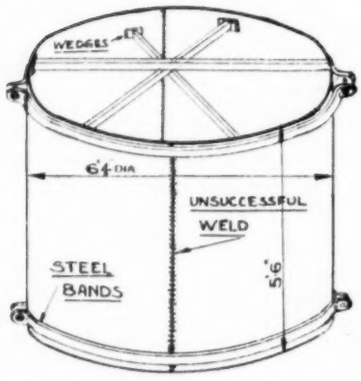


Figure 1.

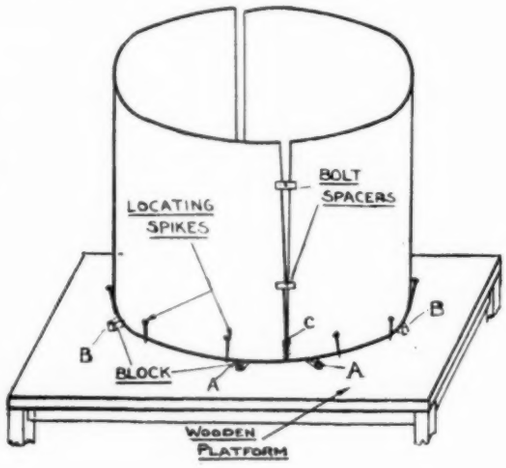


Figure 2.

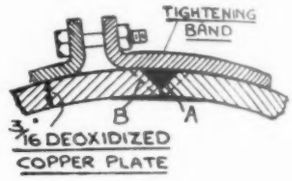


Figure 3.

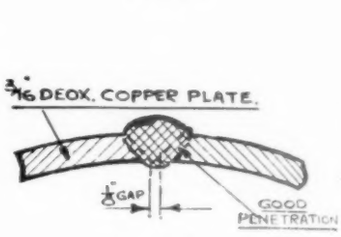


Figure 4.

In this article we are going to follow D. G. Knox† through the difficulties he encountered on this job, which, it is of interest to note, he completed successfully.

As mentioned previously, 18 vats were ordered, and, prior to Mr. Knox's entry upon the scene, two of these had been attempted, with results far from successful.

The procedure adopted for the manufacture of the first two vats was the rolling of two semi-cylindrical sheets of copper, the butting of these to form a cylinder, and the welding of each of these seams. To facilitate the welding, steel bands of 3 in. x $\frac{5}{8}$ in. steel were wrapped around the cylinder at top and bottom, and the cylinder was drawn tight by means of a bolt, as in Fig. 1, upon a mandrel, as shown. This mandrel consisted of three pieces of 4 in. x 4 in. timber, spaced as shown, with small wedges positioned as at the ends of the same, to enable the diameter of the cylinder to be varied slightly in order that the plates may be drawn together.

The seam was now tacked at three points, at approximately the centre and ends, and welding was started from one end after the cylinder had been laid on its side with the seam uppermost. It is obvious to everyone familiar with even the first principles of welding that this procedure is wrong in that no provision is made for the closing effect of a butt-welded seam when welded from one end.

Thus it can be seen that as soon as some of the seam was completed the stresses imposed upon it by preventing the distortion simply caused the weld to fail.

Mr. Knox was first called upon to remedy these two tanks, but after trying this along the lines laid down by the works manager, and being almost cremated in the attempt, he was not satisfied with this patched-up job, which incidentally failed under the pressure test.

As he was unable at the time to do anything more than offer suggestions, the powers-that-be decided that their procedure was correct, and after one month four more vats were welded, with poor results.

Hereupon, Mr. Knox was asked to discuss the job with the engineers, resulting in permission being given him to attempt the job in his own way.

The first step taken by Mr. Knox under these new conditions was to arrange for the supply to him of a specified welding torch, together with reliable accessories, such as rods, flux, etc. At his request, an assistant, equipped with a welding torch, was detailed to help with the work.

The next step was to set up the two semi-cylinders, as shown in Fig. 2, on a suitable wooden stand, packed up on suitable blocks, with the gap between the cylinders increasing in width towards the top and supported thus by bolt spacers.

The welding was started from a point about 6 inches from the bottom of the seam at C, and carried down to the bottom, then re-started from the first point and carried upwards, simultaneously moving the bolt-spacers forward to keep the correct gap.

This method proved entirely successful, and the last 12 vats were completed in less than three weeks.

Fig. 3 shows a section through the joint. That at "A" shows the method of bevelling the edges of the plate on the first attempt, and that at "B" being the bevelling of the plate edges on the second attempt. The both attempts were quite unsuccessful. It will be noticed that, in this instance, the cylinder was assembled with the steel bands, with very little bevel on the plate. These factors, coupled probably with insufficient heat, were responsible for the absolute failure as a weld. The method of patching these was to run molten brass on to the inner face of the seam, followed up by tinning and soldering.

"B" in Fig. 3 shows Mr. Knox's method of carrying out the job on the first six vats, before he was permitted to try out the welding without the bands. This was more successful than the first attempt, but, due to the locking

(Continued on page 44.)

Spot Welded Stainless in Aircraft Construction*

By Carl DeGanahl†

Here is a welding problem which illustrates forcibly the importance of metallurgical knowledge as a foundation upon which to build a procedure for making welds that must be safe. In this case timing appears to be both the most important and the most difficult phase of the problem.

A LITTLE more than two years ago an investigation of electric spot welding as particularly applied to aircraft was started by our firm. The advantages of stainless steel were soon obvious and the work quickly concentrated in this direction.

The particular stainless steel chosen is what is known as the 18-8 alloy. It contains about 18% chromium and 8% of nickel and very low carbon. The better known trade names of this alloy are Allegheny Metal made by the Allegheny Steel Company, KA2 made by the Crucible Steel Company, Carpenter 4 made by the Carpenter Steel Company and there are various other producers of the same alloy. This alloy was chosen because of its peculiar suitability to spot welding, its good forming qualities even when hard rolled and the elimination of any necessity for subsequent heat treatment. It is an austenitic alloy having physical properties strangely similar to copper. In its full annealed condition it has an ultimate tensile of around 90,000 lb. per square inch with a very low yield point around 35,000 lb. per square inch. Its elongation, however, is exceptionally high, being about 60%. It is due to this high elongation that it is such an easy metal to form and work.

These low physicals, however, can be radically changed by cold working. Strip, cold rolled as high as 220,000 lb. per square inch ultimate tensile, has been used. However, the elongation is very low, generally about 2% or less, and further forming and working is impractical. It is preferable to use it when the tensile is around 175,000 lb. per square inch and the elongation not less than 10%. In this condition almost all required sections can be formed, and thus finished sections already at high strength can be obtained without any further heat treatment. Heat treatment of a non-stainless alloy further requires sand blasting and then precautions against corrosion being taken, such as painting or electro-plating. All this is eliminated in using a stainless steel, cold rolled to high strength.

A hard rolled 18-8 alloy strip can be annealed by heating to a high temperature and quenching. It is this property that is so strangely similar to copper and quite different to the properties of most alloy steels, where the heating and quenching method is used to harden instead of soften. And, it is this property which makes the 18-8 alloy peculiarly suitable to spot welding. The very welding process is a repetition of the above method of annealing. For instance, two strips are held tightly together between copper electrodes of suitable diameter and with sufficient pressure to insure proper contact of the metal. An electric current is then turned on for a small fraction of a second passing between the two electrodes through the two metals to be welded. The metal at this point is heated almost instantly to a fusion temperature, and then the heat is conducted away by the copper electrodes and the surrounding cold metal even more rapidly than the chilling of a body of metal being quenched in water. The result is—a weld is made of annealed metal which gradually radiates out to the hard material unaffected by the heat. A tough malleable weld is therefore the result, admirably suited to fatigue.

In order to emphasize the advantage of the above type of weld, it is necessary to describe what happens when two sheets of chrome molybdenum alloy are spot welded together. Chrome molybdenum alloy is very popular in aircraft construction because it is particularly suitable for torch welding. It is commonly known as chrome moly and is hardened to any required strength up to 240,000 lb. per square inch by heating to a high temperature and then quenching, at which point it is extremely brittle. It is then drawn from some temperature suitable to the final strength required. If two sheets of chrome moly are spot welded together, the rapid conduction of the heat away from the heated area causes a ring of glass hard metal to form around the spot. A sudden slap broadside on a table is generally sufficient to rupture the weld.

Such a weld can, of course, be made satisfactory and reliable by subsequent heat treatment. A further snag exists, however. Light weight and great strength frequently necessitate fairly complicated built-up structures. A tapered wing beam about sixteen feet long in spot welded chrome moly sheet was built and was heat treated under the most advantageous conditions in an electric furnace. An astonishingly large proportion of the welds were found broken, although the ones which remained were tough and satisfactory. The mere heating up during the heat treat had brought about expansion, causing warp-

†President, Fleetwings, Inc.

*Paper presented at the Annual Meeting, American Welding Society, New York, April 27-29, 1932.

ing and internal stresses sufficient to break a great many of the welds before they could be normalized and brought to the same condition of toughness as the surrounding metal. So much for the spot welding of chrome moly, and for that matter any metal which goes brittle on chilling from a high temperature. The 18-8 alloy, on the other hand, leaves a tough and malleable weld quite suitable to withstand the fatiguing vibrations encountered in aircraft.

Spot welding has, of course, been successfully used in the automotive industry for some time, but it has been principally used on mild steel, where the carbon is exceptionally low and the chilling of the spots does not cause the same brittleness to result as it does in the higher strength alloy steels. Where electric spot welding is used for alloy steels in motor car work, subsequent heat treatment is generally a simple matter, due to the simplicity of the structures being welded, where expansion difficulties tending to rupture the welds do not come into the problem.

The 18-8 alloy has an unfortunate property which must not be lost sight of. When heated to a temperature between 500° and 900° C., the carbon tends to come out of solution and combine with the chromium, forming chromium carbide which concentrates along the crystal faces in the metal, and when this occurs the steel ceases to be stainless and becomes subject to a type of corrosion which is exceedingly dangerous. When corrosion sets in on such a piece of metal, it follows down the crystal faces into the heart of the metal causing what is called an "intergranular corrosion," with the result that the metal tends to disintegrate and fall to pieces. If a welding torch is used on the 18-8 alloy, it is almost impossible to avoid this condition occurring at some point between the weld proper and the surrounding metal unaffected by the heat of the weld, with the result that this part is readily subject to corrosion and is a source of considerable danger in aircraft structures. In a spot weld this same range of temperature must, of course, be passed through, both while the welded part is being heated and while being cooled. The reason the same area of corrosive metal does not occur around the spot weld is because the heating and cooling is so extremely rapid that the carbon has no time to come out of solution. The cooling of a spot weld is even more rapid than quenching a mass of metal when annealing, whereas in a torch welded part the length of time that the metal is in the critical range where the carbon does deposit is a matter of at least a minute or two.

Tests do show that a spot weld on an 18-8 alloy is the first part to corrode. The corrosion, however, is very materially delayed and no serious difficulties have as yet been encountered with it. An amphibian with some stainless steel parts was inspected on its return from the tropics, having operated in the Gulf of Mexico for more than a year. On inspection, a considerable amount of red deposit was found concentrated along the stainless steel trailing edge of the wing. This rustlike deposit, however, easily came off by scratching with the thumb nail and the polished steel beneath appeared perfectly intact. The only place where any etching of the 18-8 alloy could be noticed was where some ordinary iron wire was in contact with it. It could be noticed that the surface had been etched but the strength of the member was intact even though its original thickness was only ten-thousandths of an inch. The amount of metal lost in corrosion could not even be estimated although the ordinary iron wire disintegrated entirely on handling.

The operation of spot welding in itself has also been a problem. The margins of safety in aircraft structures are of necessity very limited due to low weight requirements, and it is on this account that only the finest and most reliable means of welding or fastening of parts together can be used.

When welding investigations were first started, two supposedly automatic welders were purchased and it was found necessary to completely revise the control mechanisms in order to obtain satisfactorily reliable welds of known strength. There are several variables in the control of spot welding and the suitability of a machine for general work largely depends on the facility of changing these variables, and of knowing the values in use while welding. For instance, on the rebuilt machines the pressure is controlled by varying the compression of a spring and a calibrated indicator tells the operator at a glance what pressure is being used. With this scheme the pressure can be changed in a few seconds by turning a nut and lock nut and pressures reading directly in pounds are available at all times.

The development of a suitable timing switch was a more difficult problem. One was finally developed in which the time by oscillograph record is accurate to the nearest half-cycle. The time is controlled by turning a knob and can be adjusted in steps of one cycle from one to twenty cycles.

A new type of contact point was installed that does not burn and pit, as was the case with the old machines, and is still the case with most commercial spot welders. This trouble was overcome by the use of spring arcing points outside the area of the main contacts.

At the same time that the development of suitable welder controls was going on, an endeavor was made to learn what strengths could be relied upon in welds under various conditions of thickness and diameters of spots, etc. Values of current, time and pressure, and the size of electrodes that should be used under different conditions were gradually ascertained. Generally speaking, it was found that the shortest time possible, consistent with the accuracy of the timer, gave the best results. This, it is believed, is bound up with the more rapid heating and cooling taking place in a short time weld. In other words, the shorter the time the less the surrounding metal is affected by welding heat and the more rapidly is the welded portion chilled, thereby allowing less of a change in the metal structure to occur. The deposition of any chromium carbide out of solution is in this manner entirely avoided.

Another problem in the handling of stainless steel for spot welding has been to design parts so that the welder electrodes could easily reach points where welding was required. This part of the problem has been attacked in two ways; one has been to simplify the structure so that the weld could be easily reached, and the other has been to develop trick shapes of electrodes to use where the design could not be readily simplified. The making of trick electrodes to get into queer position has been found very difficult and much the easiest way to handle the problem is to simplify the design. However, the two developments are going along hand in hand and some two to three dozen different standard shapes of electrodes have been developed which help to handle some rather difficult positions. This problem, however, is an endless one and will continue as long as spot welding is used.

Developments in Fusion Welding

By T. S. Murphy, Jr.†

What does X-Ray inspection accomplish? What characteristics of welding wire will it disclose? What characteristics of the operator? What are the exceptions? How does the shape of physical test specimens affect recorded results? How are large pressure vessels annealed? Because these questions can be answered we know that weld quality can be controlled.

INSPECTION of pressure vessels is of the most rigid nature. Although the strength of these vessels when of riveted design can be determined very accurately by formulas, other than that of destructive testing there were no means of determining the quality of the welded work.

No matter how efficient the welding operation, there always remains the possibility of imperfections beneath the surface of the weld. X-ray apparatus was installed and found to be an extremely reliable means of determining the internal nature of the welds and of the plate adjacent to them.

Figure 6 is a view of the X-ray unit. With this machine steel plates of various thicknesses have been successfully examined. In the radiography of vessels the practical limit of the equipment does not exceed four inches. The entire unit, with the exception of the controls, is compactly housed within a heavily lead-lined cab; lead, being practically immune to X-ray penetration, it affords protection from the X-ray energy to the operator and observers. This cab is mobile, being set upon tracks to make possible its being moved along the side of the vessel to be examined, or being racked toward or away from the vessel.

The X-ray tubes are mounted inside the cab and on the same framework as the adjustable openings on the side of the cab toward the vessel to be X-rayed. These openings can be raised or lowered any desired amount by controls near the operator. The rays generated by the tubes are projected out through these openings, which are of rectangular shape, 18x6 inches. These openings, or cones, as they are called, are brought up to touch the side of the vessel.

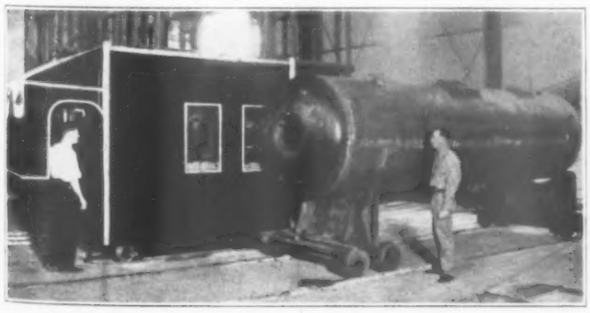


Figure 6. X-Ray Apparatus with Welded Vessel in Position for Inspection.

The longitudinal seams are taken by sixteen inch lengths. For this the seams must be laid off in sixteen inch sections before the X-raying is begun. The sections are numbered in order and these numbers are stenciled on the centerlines of the sections above or below the weld.

†The Hedges-Walsh-Weidner Co., Chattanooga, Tenn.

The same procedure is followed for the girth seams, with the circumference of the welded seam being divided into the proper number of sections. In this case, however, the numbers are stenciled on the centerline of the section but are on the plate alongside the weld. Small lead numbers are stuck on top of the stenciled numbers. This makes possible the exact locating of any imperfections to be removed from the weld, since the film can be accurately oriented to the weld by placing the film so that its number is over the number stenciled on the plate. The defect showing on the film will then be just over the defect in the welded seam.

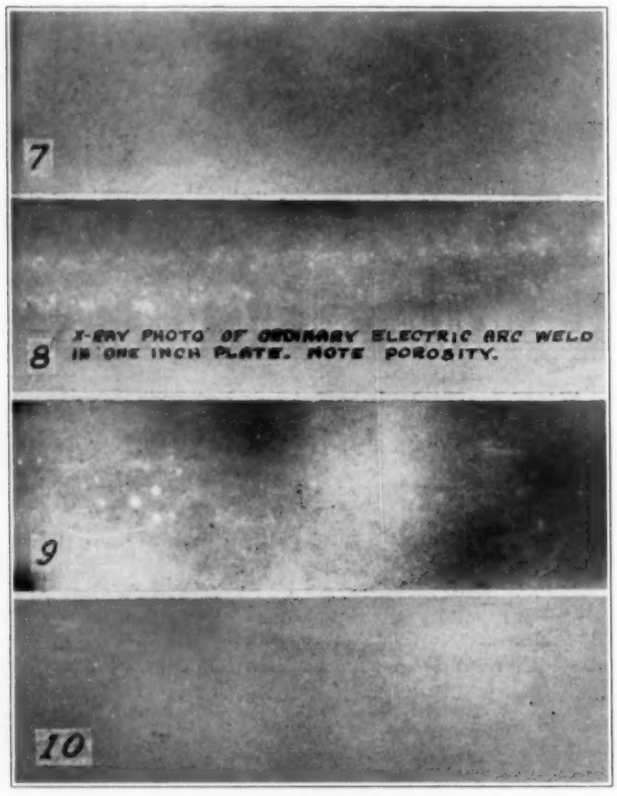
Figure 7 is a radiograph from a longitudinal seam in a 1½-in. vessel. One readily appreciates the great improvement that has been made in arc-welding when the above ideal coated-rod weld is compared with the bare rod weld shown in Fig. 8, which was made under ideal conditions by an excellent bare-rod welder. The imperfections showing in this weld are gas pockets. Physical results on this sample will be given later.

The use of radiography in examination of welding has been very satisfactory. Some curiosity, however, as to the ability of industrial installations to successfully detect imperfections in various plate thicknesses has been shown by various ones interested in pressure welding. In lighter plates, as ½" to 1½", all doubt has apparently been dispelled since suitable technic is easily established which gives not only a reliable image of the internal nature of the weld, but which also by the detection of slight surface scars, such as center punch marks, chisel scars, etc., on either surface of the plate, further proves the true value of the rays in exposing serious defects.

The most argument has arisen concerning the successful radiographing of heavy plates in which the penetrating power of the rays must be increased to such an extent that a "fogging" of the film occurs unless the proper technic is carefully established. This "fogged" effect shows penetration of lead identification markers and lack

of contrast in the various images impressed on the film. Such a film is of little more value than one in which the lack of density of the image prevents accurate diagnosis.

The radiograph of a weld in 4" plate, was recently made by the author. The technic has been adjusted to give just enough penetration to affect the film through the



Radiographs Made for Weld Inspection.

Figure 7. Radiograph of Weld in 1½-In. Plate. Figure 8. Radigraph of Bare Rod Weld in 1-In. Plate. Figure 9. Qualification Weld in 1-In. Plate Showing Slag and Gas Inclusions. Figure 10. Specimen Made by Same Welder After Interval of One Week.

full thickness of the plate, yet not enough to give penetration of the identifying number on the surface of the plate next to the film. This brings out the image of the number on the film. Four circular images were obtained on the film of ¼" diameter holes drilled to depths of 8, 6, 4 and 2 percent of the plate thickness of 4", or 0.32, 0.24, 0.16 and 0.08 inches, respectively. The contrast in densities obtained shows the absolute reliability to be had in the examination of heavier plates.

In compliance with A.S.M.E. Code regulations concerning qualification requirements for welders doing the classes of work not subject to, or only partly to, X-ray examination, each welder must make a number of welds which satisfactorily pass the physical tests. In addition, more elaborate instructions verse the qualifier in the nature of the work he is doing. Each sample weld, as completed, is X-rayed, and the resulting radiograph is explained in detail to the student by the X-ray technician, who points out any flaw which may occur and the reason for its occurrence. From this the welder is often able to remember specific conditions existing in the area containing the flaw, and by the proper adjustment of these conditions thereafter makes consistently good welds.

The sample plates are then cut into the various required coupons which are stress-relieved, tested, and the results filed on the permanent records kept for each welder.

Table I gives the average results taken for nearly 500 welded qualification plates. These results are taken from the welders' qualification records and include only those welds made from the first attempt to the point at which they were allowed to do production welding. Many of these welds were ones of a half-dozen or less, made by qualifiers who dropped or were dropped from the work for various reasons.

TABLE I

Test	Code Requirements	Average Results	% Failures
Free Bend	30% Elong. of outer fibres.	50.7%	2.6%
Tranverse Tension	55,000 lbs./sq. in.	58,300 lbs./sq. in.	9.1%
Specific Gravity of Deposited Metal	7.80	7.842	1.2%
Yield Point Deposited Metal	27,500 lbs./sq. in.	38,300 lbs./sq. in.	0. %
Elong. in 2 in. of Deposited Metal	20%	29.45%	5.0%
Tensile Strength of Deposited Metal	55,000 lbs./sq. in.	60,000 lbs./sq. in.	5.0%

Results of the bare-rod weld test (annealed) were as follows:

Free Bend Test ..... 22½°
Transverse Tension ..... 51,500 lbs./sq. in.

The X-ray is extremely accurate at detecting characteristics which prevent a weld passing the required physical tests. The only common exception to this rule is in the case of weld metal of poor quality, without porosities.

Nearly all faulty welds included in the above average would have been rejected after the X-ray examination, since probably 95% of these failures resulted directly from slag inclusions, and, in a few instances, gas pockets, beneath the surface of the weld.

Figure 9 shows typical defects in a weld made during the first week of qualifying. Figure 10 is of a typical, ideal weld made by the same qualifier a week later. Welds are in 1" plate.

Again, possibly 80% to 90% of the slag inclusions are along the side walls where the slag has either been imprisoned by undermining the sides of the groove so that slag

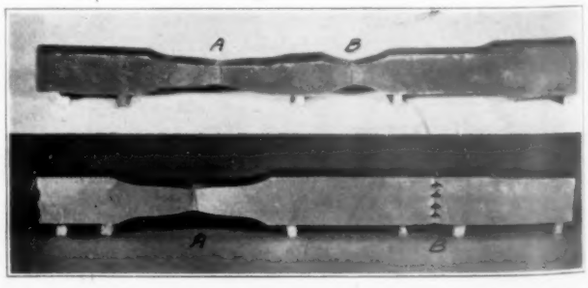


Figure 11. Short Test Sections Are Stronger in Tension Test.

In Test No. 1 (Above) Failure at "A" Occurred at 60,800 Lbs. per Sq. In. while Fracture at "B" Did Not Occur until 64,200 Lbs. Pressure Was Applied. In Test No. 2 (Below) "A" Failed at 59,600 Lbs. per Sq. In. and "B" at 76,300 Lbs. per Sq. In.

floating to the top of the fused metal is trapped by the solid metal above, or else is left along the sides during cleaning and sealed over with a following bead. Such slag inclusions caused the transverse tension test to have the largest percentage of failures, 9.1%. However, these transverse test coupons were not machined according to

Code specifications, but to specifications which, although they might be dubbed "pessimistic", are nevertheless far more accurate in determining the true strength of a welded joint in transverse tension. The Code states that transverse coupons shall be machined "in the straight" for only ¼" beyond the edge of the groove. This allows

TABLE II

Test	Average Results	% Failures
Free Bend	51% Elong. of outer fibres	0
Transverse Tension	59,500 lbs. sq. in.	0
Specific Gravity of Deposited Metal	7.845	0
Yield Point of Deposited Metal	41,300 lbs. sq. in.	0
Elongation in 2 in. of Deposited Metal	31.75%	0
Tensile Strength of Deposited Metal	61,200 lbs. sq. in.	0

the radius left by the milling tool at the end of the cut to act as a reinforcement to the side walls, thereby increasing the strength of the test section. Figure 11 is of two tests which substantiate this fact.

The transverse tests for the above average results were machined from 1" to 2" beyond the edge of the weld to permit rupture in either the plate, the side walls, or the weld, according to the weakest section.

Permanent test records are also maintained on all welded vessels. An average compiled recently covering

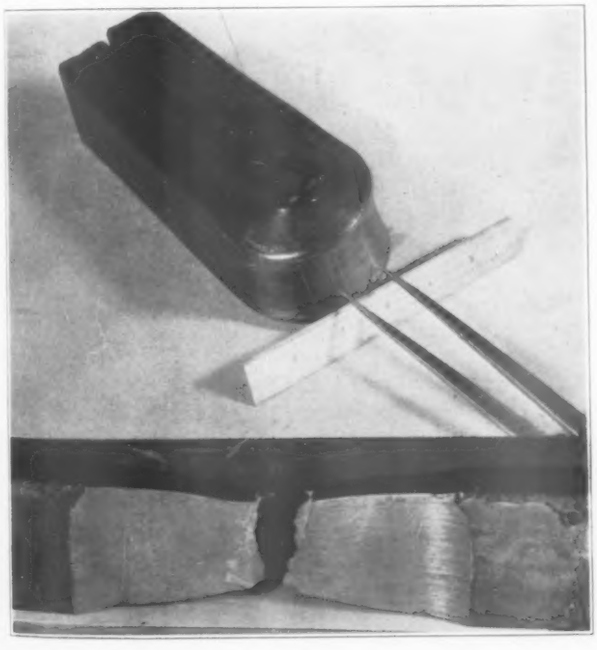


Figure 12. In Free Bend Test Shown Above, Dividers Indicate 20%, While Actual Results Shown in Outside Lines Give 59.8% Elongation. In the Tension Test (Below) 59,850 Lbs. per Sq. In. Caused Fracture.

tests on over 100 welded vessels is given in Table II.

Some excellent examples of physical tests are shown in Fig. 12.

Although the necessity for stress-relieving of welds has been previously discussed in brief, no mention has been made of the equipment employed for the purpose.

The furnace design is one for careful and unhurried consideration, since it must combine a very large capacity with sensitive temperature control, uniformity of temperature, economical and efficient operation.

The out-come of several months study of existing furnace designs and a combining of their outstanding

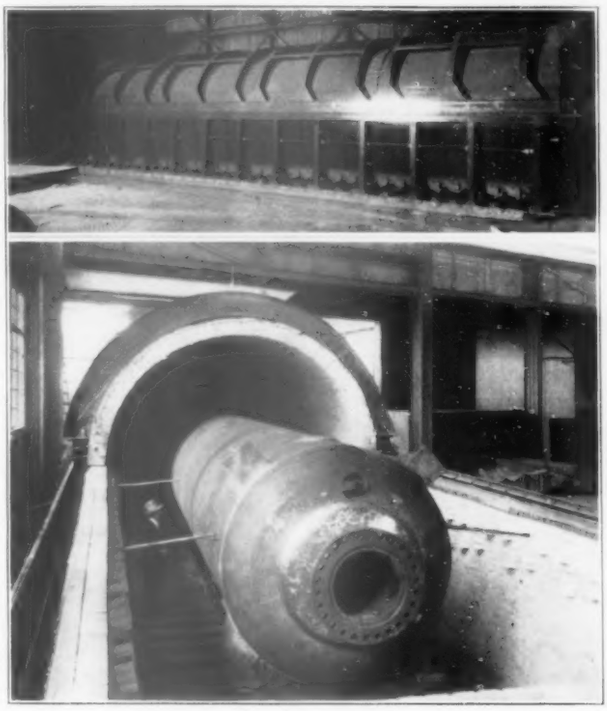


Figure 13. Side and End Views of Annealing Furnace.

advantages has resulted in the furnace shown in Figure 13. The elevated tracks at each end of the furnace allow the arch top for use with vessels up to eleven foot diameter to be rolled off and substituted for by a flat top for vessels six foot diameter and under. Each of these covers is made up of sixteen foot lengths, so that with the use of two end seals, which are handled by shop cranes, the furnace may be quickly changed from sixteen foot to thirty-two, forty-eight, or sixty-four foot lengths, of either seven foot or twelve foot inside heights. So uniform is the temperature regulation that under normal operating conditions 1250° F. is reached in two to four hours after "setting off", with maximum temperature differences at that point of about 50 degrees. Such differences usually result from attachments of nozzles and manholes to the vessel, thereby increasing the thickness of metal to be heated.

Aside from the stress-relieving of the welded seams, the temperature of the operation relieves the stresses occurring from the cold bending of the plate material, and is conceded to be of importance in further refining of the plate.

The above discussion has briefly covered only some of the developments in welding which will benefit industry to an extent beyond present estimation. Successes already realized in the welding of alloy steels are worthy of even years of diligent research. With the inspiration gained from these successes, the evolution of the welding art promises to be one of the swiftest and greatest to be witnessed by the modern steel age.

Low Costs Made Lower

(Continued from page 32)

branch, $2.41 6-inch branch, $3.05; 8-inch branch, $3.83. Compared to this the cost of welding the header connections, but by the machine were as follows: For the 4-inch branch, $1.36; for the 6-inch branch, $2.38; for the 8-inch branch, $2.72. The combined result in savings in the construction of 3-piece ells and three branch headers due to the use of machine cuts is shown in Table I:

In other words, there is a big field for utilizing the advantages of mechanically controlled cutting torches in the field of pipe fabrication. More and more confidence is being placed in welded pipe assemblies. More and more economies are being realized. The use of mechanically operated cutting torches in other industries has been steadily growing, but none too fast. Those interested in piping fields certainly have some good examples to look at in other industries to encourage them to make serious investigation of all the possibilities of applying this principle in the piping field.

Chicagoans Inspect New Steel Residence

Chicagoans interested in new types of construction had an opportunity to view a new type of all welded steel house on Sunday, April 24th. The house is located in Glenview, northwest of Chicago and has been built by the De Cel Corporation. It can be described as a 100 per cent all welded building. The exterior walls, the floors and the roof are all of sheet steel welded together, and the frame work is welded steel. The frame work, consisting of angles and junior beams, was welded in sections in the shop. These sections were assembled on the foundation to form a complete frame work. A good deal of the work of welding the exterior sheet steel wall was also done in the shop and delivered by truck to the building site for final erection.

All Welded Steel House Erected by De Cel Corporation.

This is the first house of this kind that has been built by the De Cel Corporation and it is reported that future constructions now being planned will give further improvements and at the same time reduce the time of construction.

The outstanding feature of the Glenview house is the combination of steel and glass, steel being used everywhere it was possible to use it and still leave 40 per cent of the area of the walls for glass. It has been reported that the next house to be built will have 75 per cent of its wall area in glass. A double glass has been provided for windows, the panes being separated by ¼-in. of air space to keep down heat losses and prevent condensation of moisture.

The house is 25 ft. by 24 ft., with two bedrooms, bath, nursery and dressing room upstairs, and large living room, kitchen and entrance hall on the first floor. The construction features are such that they can be adapted to any desired floor plan, but it is expected that these features will be considerably improved to make possible more flexibility in design and greater economies in production. The general plan is to provide a construction method which will allow the greatest possible use of shop fabrication so as to minimize the actual erection time.

The Glenview house was designed by J. A. Emile De-Celles of Chicago. Welding wire for shop work and field work was furnished by the Central Steel & Wire Company, and the Engineering Department of that company assisted in the supervision of the shop and field welding during the construction.

Control of Expansion in Copper Plate Welding

(Continued from page 38)

up of plate by the bands, the weld was left in a state of stress, and small cracks developed.

Several other dispositions of the sheets relative to one another were tried, but in all cases it was found that the welds were not satisfactory.

Fig. 4 shows the final method developed by Mr. Knox, and is a section through the seam on Fig. 2. In this case a distinct gap of ⅛ in. was left, and the edges were bevelled off with a chisel. A suitable flux was painted along the full length of the seam, and the bolt-spacers were positioned to keep the angle between the two sheets correct. When welding, Mr. Knox had blocks placed under the edges of the cylinder near the seam (see Fig. 2), and when the welding had progressed approximately one-third distance up the seam, these blocks were moved away from the joint, thus tending to throw the upper ends of the plates together. These blocks are shown dotted at "B" in Fig. 2.

Upon completion of the welding, it was necessary to flange over the top and bottom of the vats in order to bolt on the dished top and bottom. This was done under a steam hammer and finished off with hand hammers.

The completed vat was fitted with cast legs, the necessary gauges, together with a manhole and cover.

Rubber packing was used in the joints between the body and the top and bottom.

Under test with water, these welded vats withstood a pressure in excess of 40 lbs. per square inch without any signs of deformation and have been in constant service for some time now, completely trouble free.

During the progress of this job, Mr. Knox made a note of the approximate amounts of both oxygen and acetylene used both for heating and welding the job. These may be of use to some of our readers, and are shown below.

After the two copper sheets were placed in their rela-

tive positions for welding, the time occupied in the actual operation of welding the two seams was 1½ hours.

The gases consumed were as follows:—

For Heating Purposes	Oxygen,	37 cu. ft.
	Acetylene,	34 cu. ft.
For Welding	Oxygen,	34 cu. ft.
	Acetylene,	29 cu. ft.

New Users of Weldery Products

Enthusiastic Over Results

It is significant as a new trend in industry that 80% of the firms which the Austin Co. has served through its recently established commercial jobbing weldery in Cleveland, are companies who have never used welded parts before and are enthusiastic over their savings and advantages.

Austin reports a constantly increasing number of inquiries from firms who are interested in suggestions and definite proposals on welded parts for their use. In the case of one Cleveland firm which manufactures office equipment a saving of 25% was made over the cost of the former method of manufacture. Another Cleveland firm manufacturing special machinery saved over 40% in the cost of a base for a large polishing machine which has a capacity for polishing 1,000 automobile hub caps per hour. A machine tool builder in Detroit effected a saving of over 35% in the cost of important parts for a special machine through the use of weldings.

George A. Bryant, Jr., Executive Vice President of Austin Co., finds that consultation service is indispensable because most manufacturers have not had sufficient experience with welding. "While many companies have used welding machines to repair broken parts they have had practically no experience in the redesign of their product or special machinery to get the benefits from the use of welded parts. Business of our commercial jobbing weldery in April more than doubled March sales. Manufacturers tell us there is a real need for this new type of service and product."

Building a Job Welding Business

By W. Irving Brockson

XIII—Going on the Air

WHO would expect a job welding company to do radio advertising? Unusual as it seems, the Allen Welding Company, of Jackson, Tenn., did just that. For a period of thirty days in 1931 they broadcast a fifty-word message each day over a local station, and one definitely traceable job paid for the entire campaign.

One morning in the midst of his busy season, the owner of a hay baler broke a large gear. At noon time he was listening to his radio and heard the good news that broken parts of various sorts could be repaired by welding. Almost immediately he placed his broken gear in a truck and hauled it to the Allen Welding Company, some twenty-five miles away. The job was welded the same afternoon and the following morning the gear was back in service.

Although unusual, this radio promotional program is by no means the only sales activity of the Allen Welding Company. For years this company has been a consistent user of several kinds of sales promotion effort. To begin with, the building is well located on a prominent street, a short distance from the court house, and is thus conveniently reached by anyone desiring to bring in work. Two large modern signs, one on the front wall of the building and the other hung across the sidewalk, cannot fail to catch the eye of anyone who happens to be in the vicinity.

For another thing, a two-inch, one-column display advertisement is published in the local classified telephone directory, and serves to build prestige for the company in the minds of new prospects and old customers as well.

In the third place, conservative use is made of direct mail advertising such as folders, circulars and blotters. These are used not only to send through the mail to special prospects, but are enclosed with statements and handed out during personal calls. In this respect the company takes advantage of the imprinted advertising helps offered by manufacturers of gases, rods and other welding apparatus. Not only does this policy reduce the cost of printed material, but it also links the job welding shop with large nationally-known organizations which do a tremendous amount of advertising.

Mr. Allen, manager of the business, believes that job welders must go into the field personally to get business rather than wait for it to come in. He has shown the courage of his convictions in this connection because for nearly two years, he spent his entire time calling on the trade, leaving the shop work to a partner. Even now, when his efforts are required largely on the inside, he takes advantage of all his spare hours to visit the larger plants nearby.

The work done in this shop comes from a variety of sources such as farm machinery, railroads, automobiles, cotton gins, and miscellaneous manufacturing establishments. This diversification of customers insures a steadier income than concentration on one line of business. Not only is work done in the shop, but the portable outfit is frequently taken to jobs within a hundred-mile radius. The record on distance away from home is, in this case, 300 miles.

Mr. Allen sees a very bright future for welding. However, he believes that the process has been given a "black eye" in some instances because equipment manufacturers, in their mad scramble for larger sales, have sold outfits to small concerns for use more or less as a side line, and the actual work has been done by inexperienced, untrained operators. Under such conditions, it is only natural that some poor jobs have been turned out, with a resultant dissatisfaction with welding in general.

New Processes Well Covered at Alabama Conference

Speakers, exhibitors and visitors who attended the First Southwide Welding Conference held at Alabama Polytechnic Institute, Auburn, Ala., during the week beginning May 23rd, enjoyed a four-day program of strenuous activity. Favored by ideal weather conditions and having all of the facilities of the college at the disposal of the conference, due to the fact that the regular sessions of the school had been closed before it started, they were able to make the program the entire center of interest. During the eight lecture periods on the program, there was time for explanation and discussion of the advances which have recently been made toward greater efficiency in gas welding, arc welding and resistance welding. In addition, there were discussions of the applications of all of these processes to the welding of steel, iron, stainless steel, copper and copper alloys and aluminum and aluminum alloys. Special types of welded construction, such as structural steel, building piping, overland piping, machinery construction, tank building, plate fabrication, pressure vessel welding, automobile manufacture, etc., were well covered, a number of lectures being illustrated or accompanied by motion pictures. In addition to the actual welding portion of the program, there was a lecture and demonstration of the metal spraying process which is of considerable interest to the welding industry. Special arrangements were made to provide demonstrations of gas welding and cutting and electric welding methods, space being set aside in the shops and seats arranged so that each demonstration could be viewed by the maximum number of visitors.

Throughout the conference keen interest was shown in all of the subjects presented. A number of plants in the vicinity had arranged for men to attend on alternate days so that different ones could get the benefit of the discussions of subjects in which they were most interested. The opinion that the event was a thorough success was freely expressed by both speakers and visitors, and the officials of the college have been encouraged to start making plans for a similar conference next year. Industrial conditions made it impossible for the event to draw as large an attendance as was hoped for at first, the total being estimated at about 300, but it is expected that on the basis of this first success, a much larger attendance will probably develop in future meetings. The enthusiasm of the visitors can certainly be attributed in a large degree to the fine efforts of the speakers, exhibitors and demonstrators, but there is certainly a great deal of credit due to the officials and faculty of Alabama Polytechnic Institute who very thoughtfully provided a number of enjoyable entertainment features to supplement the regular program and make the intervening hours between the main events pleasant for everybody.

Several of the Display Booths at the First Southwide Welding Conference.

European Engineer in U. S. to Introduce Welder

O. O. Weigner, manager of the welding department of Elin Electrical Manufacturing Company, Ltd., Vienna, Austria, arrived in U. S. A. on May 20th, to exhibit and demonstrate to firms interested the Elin type of welding machine. Mr. Weigner states that several thousands of these Rosenberg D. C. cross field-arc welding machines have been sold in Europe, Russia, the Far East and South Africa.

The Rosenberg cross field generator is a self excited series wound D. C. welding generator with two working brushes and two auxiliary brushes in short circuit. Two magnetic fields crossing each other are induced, securing a stiff dropping characteristic and thereby a steady arc, using metal or carbon electrodes, without any extra resistance or reactance.

Current adjusting is by one hand wheel only, with pointer and dial, arc voltage adjusting itself automatically. Running speeds between 1100 and 2000 r. p. m. do not alter the output; one dynamo design will therefore meet the different speeds of A. C. motors of 60 and 50 cycles, D. C. motors and gas engines. Cross field generators do not alter the current flow when run clockwise or anti-clockwise.

Protected by patents granted and pending, this design is to be introduced in the United States, manufactured on a license basis or sold by sole agencies. Mr. Weigner now staying at the Lincoln Hotel, 44th St. and 8th Ave., New York City.

Welding Regulator Finds Important Use in Electrical Industry

How a piece of equipment designed primarily for use in connection with oxy-acetylene welding has found a field of usefulness in the electrical industry is related in an article, "Bottled Nitrogen for Inertiare Transformers," by H. B. West and L. E. Shoemaker, transformer engineers of the Westinghouse Electric & Mfg. Company, the article appearing in the May issue of the *Electrical Journal*. The inertiare system is a means of prolonging the life of transformer oil and insulation by keeping the gas space above the oil level in the transformer full of clean, dry nitrogen, eliminating practically all of the oxygen from the transformer. For some years this has been accomplished in large transformers by installing special chemical apparatus, and more recently the chemical apparatus has been replaced by using compressed nitrogen in commercial gas cylinders. The problem involved is that of supplying the nitrogen from the high pressure cylinder to the transformer at a pressure of approximately 8 oz. per square inch, which means that the tank pressure, ranging from 2,000 to 150 lbs. per square inch, must be reduced down to this low pressure. It is stated in the article that this reduction has been accomplished by the use of a reducing valve or regulator, which reduces the pressure in two stages.

The mechanical considerations involved in the construction and operation of the inertiare transformer set up a list of requirements which the regulator had to meet, among which were the following: To control automatically the flow of the gas into the transformer tank; to reduce the pressure from the tank pressure down to approximately 8 oz. per square inch; to close and seal positively at a pressure of about 8 oz. in the transformer tank; to operate over ranges in temperature from —40 degrees F. to +120 degrees F. without change of setting; to be free from external leaks; to be reasonably sensitive of adjustment; to operate at 8 oz.; to withstand without damage the impact pressure of the gas when the valve of a full cylinder is opened initially with atmospheric pressure in the reducing

valve; to prevent the gas from passing into the transformer so rapidly as to cause damage; to show the pressure in the nitrogen cylinder at all times. Laboratory tests were conducted to impose a service equivalent to twenty years of actual service, and subsequently equipments were installed on transformers in various parts of the United States to demonstrate the practicability of the development for commercial use. Schematic diagrams used to illustrate the article mentioned show that the regulators used are the multi-stage regulators made by the Harris Calorific Company, Cleveland, Ohio, and in the article acknowledgment is made to the engineers of the Harris Calorific Company for valuable assistance rendered in the development.

Steel Corporation Has Purchased "Shot Weld" Process

The U. S. Steel Corporation has recently negotiated a contract with the Edward G. Budd Manufacturing Company through which it has acquired the rights to the Budd System of Stainless Steel Construction, including its Shot Welding Processes, for the use of its subsidiaries in the construction of ships, bridges and structural elements in buildings.

The Budd Shot Welding System is the result of a number of years of intensive effort on the part of its engineers to successfully weld stainless steel without impairing its physical characteristics of great strength, ductility and non-corrosiveness.

The Budd company successfully demonstrated its achievement by the building last year of the first stainless steel aeroplane, which was sent to Europe recently for Continental demonstration. The great Savoia firm has already acquired rights to this system in Italy.

This year the same system of stainless steel construction was used in the building of the first pneumatic tired rail cars by the Budd company; orders for which have been placed by the Reading & Pennsylvania Railroads.

Oakland School Offers Course in Industrial Pipe Welding

The Central Trade School, located at 12th and Jefferson streets, Oakland, Cal., has recently revised its course of study in industrial pipe welding and now offers a twenty unit course requiring a minimum of 160 hours. The course is divided into three sections as follows: First, class room instruction in the properties of welding gases, safety factors, metallurgical reactions at high temperatures, design of pipe joints and physical properties of welded joints. Second, shop work in the use of templets, cutting special joints, preparation, assembly, welding and testing of pipe joints and pipe fittings. Third, class room work in making up and laying out templets for fittings used in plumbing installations.

Welding is performed on pipe up to 6 in. in diameter, and elementary instruction and shop work on the welding of iron castings and brass is included, if requested. All the common types of joints and fittings are on display so that students can see what properly executed work looks like. Lesson sheets are provided for the class room work. The student makes up a pattern for a fitting in the class room and uses the same pattern for his work in the shop. It is a requirement that fittings fabricated in the shop must conform to standard specifications.

A.W.S. Los Angeles Section Holds Educational Session

Three interesting and profitable talks were heard and enjoyed at the meeting of the Los Angeles section of the American Welding Society, which was held on May 19th at the Frank Wiggins Trade School.

The subjects of talks were:

"General Objectives of Vocational Training," by A. G. Waidelich, Vice-Principal of the Frank Wiggins Trade School, in Los Angeles.

"Training of Welding Students," by J. W. McCartney, Welding Instructor in the same school.

"Expansion and Contraction," by C. J. Nyquist, local dealer in welding equipment and supplies and Chairman of the Program Committee of the section.

Mr. Nyquist illustrated and explained in a comprehensive way portions of his talk by using detailed charts, tables and sketches.

Welding Progress in Poland Covered in Report

On April 22nd of this year the Association for the Development of Welding and Cutting of Metals in Poland published a report covering the activities of the association from 1927 to 1931. The association was founded in 1927 by manufacturers of calcium carbide and oxygen in Poland, and in that time has been very active in the dissemination of information. Eighty-three courses of instruction have been given with 2,287 pupils attending, among whom were 245 engineers and 40 teachers. A monthly official organ has been published as well as four instruction manuals. A number of conferences have been held and consultations have been arranged with many shops and factories. The association keeps in close touch with the activities and publications of similar associations throughout the civilized world. Altogether it is to be congratulated on the good work which it has accomplished for the welding industry in Poland during the four years of its existence.

Italy Has a New Carbide Plant

A recent issue of the *Venice Gazette*, Venice, Italy, carries a feature story of new industrial establishments which are making progress at the Port of Marghera. Special mention is made of the new plant for the production of calcium carbide, which has been completed during the past two years. It is reported that carbide is being used to an increasing extent for the production of acetylene for oxy-acetylene welding and marine lighting. There is an additional demand, however, for carbide in the manufacture of chemicals for fertilizing land which has been nearly exhausted by thousands of years of farming.

Truck Mounted Welding Shop Does Good Business

The May 12 issue of the Harrisburg (Pa.) *Patriot*, carries a story of the portable welding shop operated as a part of the Harrisburg Welding & Brazing Company business. The equipment which is mounted on a 1½-ton truck includes outfits for oxy-acetylene and electric welding as well as an air compressor and a full outfit of tools. John Armstrong, head of the concern believes that it is the only portable shop of its kind in that part of Pennsylvania. The unit has been taken to far parts of the state for repairing bridges, boilers, tractors, road rollers, broken gears and many other jobs that can be welded. This type of service is a convenience to the customer, giving him economical and quick service.

Oxy-Acetylene Committee at Work on New Report

The Oxy-Acetylene Committee of the International Acetylene Association got under way with its 1932 activities at a general meeting held on Tuesday, June 7th, the meeting being held for the purpose of discussing the scope and arrangement of each section of the Oxy-Acetylene Committee Report, which is to be presented at the Annual Meeting later in the year. For several years this report has been published in book form and has constituted a valuable record of the progress made in the industry as well as a source of useful information to all those interested in any way in the oxy-acetylene processes. Advance notices indicate that the report this year will assist in expanding present knowledge of important activities other than actual applications of the processes.

New Bulletin on Hansen Welders

"The Novice Understands and the Expert Appreciates" is the title of a bulletin recently published by the Harnischfeger Corporation of Milwaukee, describing in detail the construction and operating advantages of the P & H—Hansen Arc Welder, now manufactured exclusively by Harnischfeger. Of particular interest to welders is the description of the so-called "Internal Stabilizer" which in the P & H—Hansen Welder takes the place of the external stabilizer. The advantage claimed for the new type stabilizer is in the elimination of weight and extra equipment plus the assurance of a more uniform flow of current and a consequent increase in the efficiency of the arc.

Other features of the P & H—Hansen Arc Welder include provision for the elimination of the exciter, and a simple and effective single control for gradations in the welding current. The several P & H—Hansen models ranging from 100 to 800 amperes in capacity are pictured and described in the new bulletin.

Further Treatment of Levers in Lincoln Bulletin

Application Sheet No. 30, Series 2, distributed by the Lincoln Electric Co., Cleveland, Ohio, deals further with the design and welded construction of levers. Those shown are of somewhat more complicated structure and cover other methods of force and load application about the fulrum. In all the cases shown, the parts are cut to shape with the torch and structured together with the arc.

Safety in the Manufacture and Use of Acetylene

A 188-page book with the above title has just been published by International Labor Office (League of Nations) covering a lengthy study on this subject. The first of the two parts into which the book is divided covers the technical processes in the manufacture and use of acetylene and the incidental accident risks. Two introductory chapters deal with calcium carbide and acetylene, properties, chemical actions, storage, etc. A chapter on the manufacture of acetylene takes up systems of generation, storage, requirements in the construction of generators and other points. Other features discussed are installation of acetylene plants, storage, and utilization. Part II lists the legislative measures adopted in many countries for the prevention of accidents in manufacture and use. There is an appendix and bibliography. Copies of the book may be obtained from the World Peace Foundation, 40 Mount Vernon St., Boston, Mass. The price is $1.50.

New G E Bulletin Describes Electrodes and Accessories

A new 16-page bulletin now being distributed by the General Electric Co., describes and illustrates the complete line of arc welding electrodes of their manufacture. A representative group of illustrations points out the many applications of these products to items adaptable to welded manufacture. Descriptions of various arc welding accessories are also included as well as types of welding generators.

A New Steel Flooring Utilizes Welding

The development of a new steel flooring after long scientific investigation has been announced by Mellon Institute of Industrial Research, Pittsburgh, Pa. This flooring consists of slabs, 24 inches wide and up to 12 feet 5 inches in length at present, that are fabricated by preforming two steel sheets and subsequently welding them together in the plane above the neutral axis. A cross-section taken through the width of a completed unit shows four keystone-shaped cells, all connected together near the neutral axis. These four ducts, which constitute each unit, are spaced at six-inch intervals and connect directly, when installed, with the corresponding ducts of the adjacent section of floor slab. This arrangement is described as enabling the utilization of the new floor not only as an efficient load-carrying member, but also as a multiple floor-duct system for handling all types of electrical lines. Such a grouping of parallel cells with six-inch spacing is claimed to permit, at any time, the installation of electrical outlets within a radius of three inches from the exact location required, thus providing permanent electrical flexibility and precluding electrical obsolescence.

It is said that the keystone slab can be installed with ease and rapidity; that it can be bolted, clipped, or welded into place across the structural members, affording a working floor for the various trades. This floor is fire-safe; it is adaptable to appropriate finishes and to suspended ceilings and service piping, and has a low weight per square foot.

Faulk Will Market New Cover Glass

Ever-Klear, a cover lens for welding helmets that prevents flying molten sparks from fusing to the surface, eliminating pitted glass, blurred vision, prismatic defects and eye strain, allowing the operator to see the weld clearly at all times, has been placed on the market by F. R. Faulk, 50 Penn avenue, Pittsburgh, Pa., exclusive distributor. This new cover glass is guaranteed two hundred hours.

New Welding Hose is Heat Resisting

Announcement has been received of the production of a special hose for oxy-acetylene welding by B. F. Goodrich Rubber Company, Akron, Ohio. This hose is said to be of a specially compounded rubber to give it heat resisting qualities. For the wrappings braided asbestos yarn is used on the outside ply and a special fabric wrapping for the inner plies with a rubber covering 3/32 inch thick. The hose is made in the red and green colors and furnished in sizes 1/4, 5/16 and 3/8 inch.

Two New Regulators Announced by Linde

The Linde Air Products Co., New York, has recently added two new regulators, the Oxweld type R-48 oxygen regulator and Type R-49 acetylene regulator to its line of welding and cutting apparatus. These new regulators have been designed to provide a pair of lighter duty regulators, particularly for use with outfits for sheet metal welding.

These new regulators are of the stem type. The bonnet is held in place by a forged brass cap ring to assure a non-leaking diaphragm. Assembly and disassembly are facilitated by the ribbed cap ring.

The Monel metal stem is similar to that used in other regulators in the line. It is detached from the diaphragm thus providing increased smoothness in the operation of the regulating mechanism. The diaphragm is of rubber composition material, and the springs are made of cadmium-plated steel. Pressure forgings are used in the body cap ring and pressure adjusting screw. This screw has a high thread pitch which permits rapid pressure adjustment. A new type of safety release is incorporated. The hose connection on the Type R-48 is for 1/4-in. oxygen hose, and on the Type R-49 is for 3/8-in. acetylene hose. Other size hose connections can be supplied, if required.

Oxweld Type R-48 Oxygen Regulator.

A Bronze Electrode for Cast Iron

Whelite Distributors, 1732 E. Seventh Street, Los Angeles, Cal., have announced a bronze electrode for electric welding of cast iron. This is a hard drawn bronze wire which operates without coating or flux. The electrodes operate with reverse polarity at voltages of 25 to 35 and 100 to 150 amperes current. It is necessary to hold a very short arc in order to get best results. The manufacturers claim that the electrodes are of sufficient hardness for any work, allowing for perfect machining when necessary, and that its strength is twice that of cast iron. The electrode is supplied in three different sizes so that the welding of material of different thicknesses is made possible.

New Lincoln Electrode Holder Stand Saves Power

A new electrode holder stand which automatically shuts down the welder 1 minute after holder is placed on stand and instantly starts the welder when holder is removed, is announced by The Lincoln Electric Co., Cleveland, Ohio, and will be known as the Lincoln "Power Saver."

It is claimed that the automatic start-and-stop feature of the new stand effects

10,000 gallon Everdur Tank fabricated by Whitlock Coil Pipe Co., Hartford, Conn. Every seam was electrically welded in three layers with Everdur Rod, each layer being peened and annealed to assure uniform grain structure and maximum strength.

EVERDUR

combines high strength and corrosion-resistance . . . *is easy to weld*

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

For Oxy-Acetylene Welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

For Arc Welding

Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

The development of Everdur has made possible the economical fabrication by welding of metal products requiring the strength of steel and the corrosion-resistance of Copper. Everdur* is an exclusive Anaconda metal (Copper, alloyed with silicon and manganese), and is readily welded with Everdur rod by all commonly used methods.

Other applications of Everdur rod

Everdur rod is used to advantage in oxy-acetylene and carbon or metal arc welding. Everdur alloys readily with Copper, Brass, Bronze and the Copper-Nickel alloys, making welds of exceptionally high strength. It is non-magnetic and possesses about the same electrical resistivity as steel. It melts at 1860° F.

Anaconda Publication E-4, containing detailed information on the welding properties of Everdur and the procedure to be followed in welding this metal, is available upon request.

*Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
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ANACONDA WELDING RODS

a decided saving in power consumption. Heretofore it has been common practice to let the welder run continuously during working hours even though the operator may actually be welding intermittently throughout the day.

By shutting the machine down when the operator is not actually welding, power will be saved and the overall power factor of the plant raised, since as is common with most motor operated devices when operating at light or no loads the power factor is reduced. Thus by shutting the machine down during idle times, it will at no time be operating at reduced power factor. It is claimed that the saving in power consumption will pay for the "Power Saver" in a short time.

Operation of the stand is extremely simple. When the hook is depressed by the weight of the holder it activates a special timing device which, at the end of 1 minute, disconnects the welder from the power supply line. When the holder is removed from the hook the welder starts automatically.

The stand as shown in the accompanying illustration is of arc welded steel construction throughout. Its

Lincoln Power Saver Stand.

bread, heavy base provides ample rigidity, yet does not impair its portability. The holder hook can be raised or lowered on the upright member to suit the convenience of the operator. Fifteen feet of rubber covered, two conductor cable is provided with stand for connection to welder. The "Power Saver" can be used whenever the welding equipment is provided with an automatic motor starter having two wire pilot control.

News of the Industry

Welding will be employed extensively in the early erection of a large market in Los Angeles, Cal., at 1900 Washington Blvd. The building, the construction of which is practicaly all metal in one form or another, will be built for Gideon Le Sage, local market owner. Included in the materials to be used are metal roof vents, structural steel frame, steel sash, steel accordion doors, and metal clad doors, all of which in their manufacture and installation, welding plays and will play a prominent part. The cost of the structure will approximate $19,000.

The Santa Maria (California) Gas Company announces that it will begin construction about June 5th on an 8-inch welded natural gas pipe line to extend from the Santa Maria River to Oilport, north of Pismo Beach. The length of the line will be about 22 miles, and will be welded by the oxy-acetylene process.

The Allsteel Press Co., Inc., 12015 South Peoria St., Chicago, manufacturers of the Verson Allsteel line of punch presses, have established a commercial welding department to handle jobbing work.

Broken press frames, beds, rams and gears may readily be replaced with welded steel plate units at low cost as no patterns or castings are necessary.

Machine and column bases, gang punch attachments, large die sets, jigs, fixtures and a great variety of machine parts of welded construction may be furnished promptly and at a considerable saving in weight and cost, yet with greatly increased strength and rigidity. The experience gained in pioneering welded steel plate presses and designing replacement parts for cast presses and other machinery is at the disposal of any manufacturer interested.

F. L. Lindemuth has been appointed chief engineer of the William B. Pollock Company, Youngstown, Ohio, engineers, fabricators and erectors of steel construction of all kinds. Mr. Lindemuth was formerly connected with the Mesta Machine Company, Perin & Marshall and the Colorado Fuel & Iron Company.

Russel R. Lentz, Jefferson Lentz and Edward Meyer have purchased the Prosch Boiler Works, 1430 Ash St., Terre Haute, Ind. This plant has been established for 30 years and specializes in the manufacture of boilers, tanks, stacks and structural steel for continuation of which new equipment is to be installed.

Harrisburg Pipe & Pipe Bending Co., Harrisburg, Pa., manufacturers of unmachined drop forged steel pipe flanges, has completed the installation of machinery for machining flanges of this type. They are now equipped to furnish pipe flanges either rough or machined in all threaded types or in high or low welding neck types.

Forrest U. Webster, advertising manager, Culter-Hammer, Inc., Milwaukee, Wis., was elected president, National Industrial Advertisers Association at the annual convention recently held in Cleveland.

Herman Knaebe died in Milwaukee after a prolonged illness on May 17th at the age of 37. He was president of the Mid-West Welding Co., which he established in 1923.

Welding Service Company has moved to new quarters at 75 West St., New York City. Their old address was 50 Church St.

The William B. Pollock Co., Youngstown, Ohio, have appointed Presley Hamilton, Room 2210, 149 Broadway, New York City, sales representative in that district. The William B. Pollock Co. is engaged in engineering, fabricating and erecting miscellaneous riveted and welded steel construction of all kinds.

D. H. Skeen & Company, 1 North La Salle St., Chicago, distributors of Tube Turns, Weldolets and Thredolets, devoted the major portion of the May issue of their house organ *Skeen Points* to announcements and descriptions of these fittings, complete stocks of which are now carried in their warehouse.

The Gulf Coast Pipe Line Company, in the Saxet oil field of Nueces County, Texas, is laying an oxy-acetylene welded pipe line for transporting oil from that field to Corpus Christi. The line will be six inches in diameter. At Corpus Christi, the company has under construction an 80,000-barrel welded steel storage tank as a nucleus for a possible future tank farm there. The pipe line will have a daily capacity of 20,000 barrels.

Frederick W. Snook Co., San Francisco, Cal., has been awarded a government contract which will involve a great deal of welding. The contract calls for the installation of boiler plant equipment and welded piping systems in connection with the new U. S. naval air station being constructed at Sunnyvale, Cal.

L. G. Frick, of Los Angeles, formerly superintendent of field welding on pipe line work for the A. O. Smith Corp., Milwaukee, Wis., is now associated as general manager and secretary of a newly-organized concern in Los Angeles for handling general welding contracts. The name of the new concern will be known as The Arc Welding Corp., and is located at 2376 East 51st St. New 300 and 400-amp. gas engine driven Hobart welding units were recently installed in the new plant.

The Water Power Department of the city of Los Angeles is completing plans for the installation of a 1,900-foot welded penstock which will be located at one of the city's power plants near San Fernando. Fabrication of the pipe for this penstock will be by automatic electric machine welding and will also be installed by electric welding.

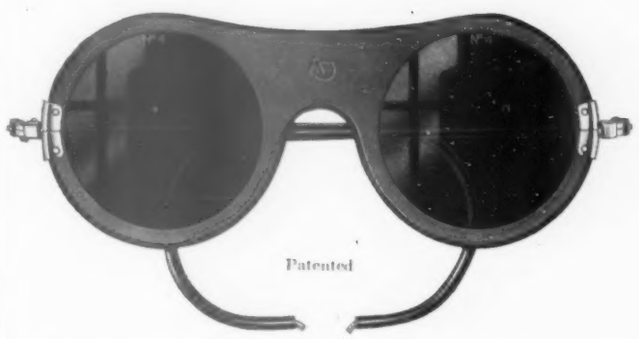
M. H. Turner, of the Home Oxygen Company, Huntington Park, Cal., has been confined to his home for some time by severe illness. He is reported considerably improved. Mr. Turner is secretary-treasurer of the Los Angeles section of the American Welding Society.

C. J. Nyquist, of Weldcraft Service & Supply Co., Los Angeles, Cal., and well known throughout the welding industry in that city, has been appointed a member of the Vocational Education Division of the Los Angeles Board of Education. Mr. Nyquist will act on the Welding Trade Advisory Educational Committee.

(*Continued from Page 30*)

85	Louis K. Whitcomb, Jr., C.E., c/o Carnegie Steel Co., 1405 Rockefeller Bldg., Cleveland, O.	The Arc Welded Steel Frame House	100
89	Gilbert S. Schaller, Assoc. Prof. Shop Eng., University of Washington, Seattle, Wash.	Welded Engine Lathe	100
90	John Wambach, Eng. Cond. Dept., C. H. Kertes Sales Eng., Allis-Chalmers Mfg. Co., Milwaukee, Wis.	Welded Steam Expansion Ring	100
91	Jules J. Siekman, 14819 Seeley Ave., Harvey, Ill. (Of Austin Mfg. Co.)	Welded Road Graders	100
100	Chas. O. Barclay, 204 Washington St., Portsmouth, Va., (U. S. Norfolk Navy Yard)	Welded Pipe Fitting	100
105	Richard P. Hawkins, 1350 Highland Ave., Rochester, N. Y. (Engr. M. D. Knowlton Co.)	Paper Box Machine	100
112	W. P. Michell, 315 So. 15th St., Allentown, Pa. (International Motor Co.) (Mack Plant).	Welded Motor Truck Parts	100
114	K. T. Sorensen, Designing Engineer, c/o Baldwin Southwark Corp, Philadelphia, Pa.	The Redesign of a Dough Mixer	100
116	A. S. McCawley, 5504 Barry Ave., Chicago, Ill. (Estimator & Supt. Thos. J. Douglass & Co.)	Pipe Line Fabrication	100
127	K. Jurczyk, Georgsmarienhutte, b/Osnabruck Schloss Str. 6, Germany (Ch. Engr., Klockner Werke).	Modernizing a Rolling Mill	100
132	Abraham Nechin, 633 Addison St., Chicago. (Ch. Eng. & Gen. Mgr. Nechin Iron Works).	Welded Steel Floors	100
141	H. C. Boardman, Res. Engr. and John F. Marsh, Engineer, Chicago Bridge & Iron Co., 1305 W. 105th St., Chicago, Ill.	Steel Spheres for Gas Storage	100
145	Edwin B. Wheeler, Electric Boat Company, Groton, Conn. (Shipbuilding Manager).	Welded Small Craft	100
153	Richard W. Stanley, 61 Morrow Ave., Lockport, N. Y. (Merritt Engrg. & Sales Co., Inc.).	Arc Welded Milling Machine	100
155	Walter de Fries, P. O. Box 241, Youngstown, Ohio.	Hot Metal Car	100
160	William C. Willard, P. O. Box 845, Buffalo, N. Y. (Buffalo Forge Co.)	Welded Fan Structures	100
168	Mills G. Clark, President, Insulated Steel Floor & Wall Co. 10965 Carnegie Ave., Cleveland, Ohio.	Welded Steel Floor	100
176	John L. Howie, Jr., 740 East North St., Decatur, Ill. (Ch. Engr., The Gregoleit Company).	An Arc Welded Heat Exchanger	100
192	Everett Chapman, Director of Development and Research, Lukenweld, Inc., Coatesville, Pa.	500 Ton Precision Press	100
195	T. F. Bright, Struct. Eng., 3730 Metropolitan Ave., Argentine Station, Kansas City, Kansas.	Riveted vs Welded Purifiers	100
217	Colin O'Neal Skinner, Amer. Inst. of Steel Const., 200 Madison Ave., New York, N. Y.	Welded Steel Floors	100
225	L. F. Seelar, 7154 Amherst Ave., University City, Mo. (Ch. Eng., St. Louis Car Co., St. Louis, Mo.)	Underframe for Rail Car	100
242	Robert Sarazin, 74 Rue Bergnise, Neuilly-sur-Siene, France. (Welding Consulting Engr., Societe Babcock-Wilcox).	Welding of Big Boiler Drums	100
245	Georg Hafergut, Klammstr 203, Weiz bei Graz, Austria. (Elin Aktiengesellschaft fulelektrische Industrie, Weiz).	Arc Welded Electric Truck	100
250	Albert de Pfyffer, C. E., Structural Engineering Dept., Pacific Electric Ry. Co., 661 Pacific Elec. Bldg., Los Angeles, Calif.	Wooden Arch Roof	100
251	Aubrey F. Burstall, Engr. in charge of Welding, and Harold Kenney, Asst. Engr., Welding Dept., and Reginald A. Smith, Asst. Engr. Welding Dept., Imperial Chemical House, Millbank, Westminster, S.W.(T) London, Eng. (Address: Imperial Chemical Industries, Ltd. Billingham, Stockton-on-Tees, Eng.)	A New Method of Making Welded Structures	100
257	George Robert Cockburn, "Buiston" 80 Champion Rd., Tennyson Point, Gladesville, New South Sales, Australia.	Arc Welding Applied to Railroad Bridge	100
267	Lucien J. Vandeperre, 41, Rue Forestiere, Brussels, Belgium. (Deputy Prof. of Brussels Univ.) and Andre Beckers, "La Construction Soudee," Haren by Brussels, Belgium.	Aeroplane Hanger	100

Keep COOL *with* 1104 FIBRE WELDING GOGGLES



Phew! It's hot! And you're wearing the wrong goggles for a light welding job! Why raise your temperature unnecessarily?

Here's your goggle—the 1104 Fibre Welding Goggle—made of non-heat-conducting fibre with fully insulated temples. It keeps your Fahrenheit down on hot days and is mighty comfortable the year 'round.

The 1104 hasn't any frills—but for genuine protection on light welding jobs it's hard to beat. Tell us the kind of welding jobs you do and we'll put in the shade of Calobar or Noviweld lenses which will give *you* the greatest protection and clearest vision for your particular work.

1104 FIBRE WELDING GOGGLE

J459

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AMERICAN OPTICAL COMPANY

Southbridge, Massachusetts

●

Safety Branches in All Principal Cities

The California division of H. C. Price, Inc., announce they have been awarded the electric welding contract for 45 miles of 12-inch pipe on the Los Angeles-San Diego Line being laid by the Southern Counties Gas Company of Los Angeles. Lindgren & Swinerton, Inc., are the general contractors. Work on the line has already started.

The National Biscuit Company, Seattle, Wash., contemplate the early erection of an addition to their factory at 6th Street and Connecticut. This work will include extensive use of welding, as it will be of structural steel and the plans also call for considerable miscellaneous welded iron and sheet metal work.

A new plant, which will employ welding almost exclusively in the fabrication of its products, has just been completed in the Central Manufacturing District of Los Angeles, Cal. The Druwhit Metal Products Company is the name of the concern, which will soon start on production of its full line of welded architectural and commercial metal window products. Among other up-to-date plant equipment, a new Taylor-Winfield electric resistance welding unit and also a new 200-amp. U. S. L. electric welding machine have been installed.

Production and administration of the company will be handled by William Dreusike, president, and Edward Dreusike, secretary-treasurer, both of whom have been connected with the steel industry and engaged in the manufacture of welded products in California for many years.

A new booklet, "Lukenweld Construction," just published by Lukenweld, Inc., Coatesville, Pa., contains nearly a hundred illustrations of welded machinery parts or machinery employing welded parts. The firm does not fabricate tanks, pipe or pressure vessels nor engage in the manufacture of finished machinery or equipment of any type.

R. A. Davidson, formerly district salesmanager for Lincoln Electric Co., in Chicago, joined the organization of the Hollup Corporation, Chicago, on June 1st, as general Sales Manager.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

FOR SALE

For Sale—$3,656.00 worth of equipment and stock. A well paying business established 12 years. You will want to know more about this offer, especially the cash price. Write the Electric Welding Works, 16 W. Haley St., Santa Barbara, Cal.

BUSINESS OPPORTUNITIES

Partner Wanted—In small compressed acetylene plant, must be competent operator and take some financial interest. Address Box 458, The Welding Engineer.

POSITIONS WANTED

Licensed Structural Engineer—Welding expert, with exceptional executive ability desires connections. Sixteen years experience covering steel structures and plate fabrication. Excellent references. Box 459, The Welding Engineer. 2x's.

Designing Engineer—College graduate, 12 years experience in machine design and steel design. Last 6 years redesigning castings and steel to welded steel construction. Will go anywhere. References. Address Box 460, The Welding Engineer.

Arc Welder—First class, 7 years practical experience on all kinds of work. Desire position, preferably as demonstrator or maintenance man. Go anywhere; steady, single and sober. Mitchell Hann, Glen Gardner, N. J.

Combination Welder—Trained in General Electric arc welding school. Also capable sheet metal, plate and structural layout man. Twelve years experience. Can furnish good references. G. Edw. Poe, 825 View St., Hagerstown, Md.

Arc Welder and layout man desires position. Can layout from undetailed drawings. Seven years all around welding experience. John Bernet, 219 14th St., Sharpsburg, Pa.

Combination Welder and Automobile mechanic wants a steady job. Can furnish good references. Arthur N. Lowrie, 28 Grow Ave., Montrose, Pa.

Supervising Welding Engineer with 3 years practical experience in cost reduction by redesign for welding particularly in ⅜- and ⅝-in. plate. Know practical arc welding and gas cutting. Will travel if position is permanent. R. E. Bauer, 143 N. Parkside Ave., Chicago, Ill.

Aid Liquefaction Plant Engineer, manager and superintendent, thoroughly experienced in production of oxygen and nitrogen; electrolite production of oxygen and hydrogen; acetylene. Proven capability as manager and constructor of large industrial gas plants here and abroad; qualified to conduct plants on thoroughly economical basis and to provide for modern construction and improvements. Will consider connection in U. S. or S. America; excellent references; speak English, German, Spanish. Address Box 454, The Welding Engineer.

Structural Engineer and Sales Manager—Familiar with structural steel and ornamental iron work. Desires to form a connection with a manufacturer specializing in, or wishing to specialize in the manufacture and erection of structural steel and ornamental iron by welding methods. Would desire to make some investment. Address Box 461, care The Welding Engineer. 2x's.

Responsible Dealers Wanted

Competitive tests prove that the Smith-Waters Welder can save as much as 50% in welding operating costs. The stable arc assures constant deposition of weld metal. No moving parts. This machine is unconditionally guaranteed for two years.

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David H. Smith & Sons, Inc., 135—51 Street, Brooklyn, N. Y.

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